

As a result of advancements in automotive technology, today's tire and wheel/rim fitments require special attention. By design, radial tire construction and low aspect ratios contribute to a vehicle's ride and handling quality. Proper tire mounting, balancing and installation are critical to attaining a smooth vehicle ride. Vehicle vibration and a suspected problem tire may actually be due to an improperly balanced tire and wheel assembly or related to the mechanical condition of the vehicle.

### **BALANCING**

The technical definition of balance is the uniform distribution of mass about an axis of rotation, where the center of gravity is in the same location as the center of rotation.

A balanced tire is one where mass of the tire – when mounted on its wheel and the car's axle – is uniformly distributed around the axle (its center of rotation). Balanced tires can spell the difference between a positive and negative driving experience. Drivers of new, high performance or luxury vehicles may be more sensitive to imbalance problems, but no driver is happy with an annoying vibration.

An out-of-balance tire and wheel assembly:

- Degrades ride quality and driver comfort.
- Shortens the life of tires, bearings, shock absorber, and other suspension components.

Vibration is the most noticeable effect of imbalance.

- It is dependent on vehicle speed and may be felt in the steering wheel, seats or floor board.
- It often first becomes apparent between 40 and 45 mph and changes in magnitude with greater speeds.

Because of this, Yokohama customers with ride complaints, especially those with original equipment tires, should be serviced according to Rubber Manufacturers Association (RMA) guidelines and this Yokohama bulletin. RMA publications can be obtained directly by calling (202)682-4800, or accessing their website-[www.rma.org/](http://www.rma.org/). Ask for "Care & Service of Automobile and Light Truck Tires" publication.

To properly diagnose vibration complaints, it is important to first understand the types and causes of imbalance.

### **TYPES OF IMBALANCE** See Figure 1 On Page 3

**Static Imbalance:** Vertical movement resulting from heavy or light spots in a tire. Can be corrected using either a static "bubble" balancer or dynamic "spin" balancer.

**Dynamic Imbalance:** Lateral movement (wobble or shimmy) resulting from unequal weight on both sides of the tire and wheel/rim assembly's circumferential centerline. Can only be corrected using a dynamic "spin" balancer.

**Run Out Imbalance:** Excessive radial and/or lateral movement resulting from tire or wheel/rim non-uniformity, improper bead seating, or improper match mounting of the tire and wheel/rim assembly. This can be corrected by measuring the amount of tire and wheel/rim assembly run out (lateral and radial) with a gauge, and replacing the component having excessive run out.

**Vehicle Imbalance:** Vibration due to faulty vehicle components other than the tire or wheel/rim assembly; such as hubs, brake rotors and drums, and drive lines. Correction requires checking for any irregularities, and replacement as required.

### **Sources of Imbalance**

Two sources of imbalance occur in tires: heavy or light spots in the tire, and radial or lateral run out. Imbalance also can be caused by:

- Variations within the wheel, such as thickness and welds.
- Rotor and axle imbalances.

Heavy or Light Spot Imbalance: There are two types of imbalance caused by heavy or light spots, static and dynamic.

- Static Imbalance: Occurs when there is a heavy or light spot in the tire so that the tire won't roll evenly and the tire/wheel assembly undergoes an up-and-down movement
- Dynamic Imbalance: Occurs when there is unequal weight on both sides of the tire/wheel assembly's circumferential centerline. The tire/wheel assembly has a side-to-side wobble or wheel shimmy.

Heavy or Light Spot Balancing: Corrected either statically or dynamically, depending on the type of imbalance.

- Static Balance: Achieved with a static "bubble" balancer but does not correct for dynamic imbalance.
- Dynamic Balance: Achieved with a dynamic "spin" balancer where the tire/wheel assembly is balanced both statically and dynamically.

Radial or Lateral Run-out Imbalance:

This results from improper bead seating on the rim or the placement of components. Improper bead seating is usually the result of improper mounting or the use of improperly made wheels. A small degree of this imbalance is acceptable, but too great a run-out causes vibration and excessive tire wear.

- Radial Run-out: An "out-of-round" situation where vibrations are produced as the wheel spindle moves up and down.
- Lateral Run-out: A side-to-side or wobbling movement of the tire and wheel. It is less common than radial run-out. Sensitivity of a vehicle to vibration from radial run out is four to eight times that of wobble from lateral run out.

Run-out Balancing: Corrected depending on whether it is radial or lateral run out. See Figure 2 On Page 3.

- Radial run out balancing: Achieved by rotating the wheel and tire assembly two stud positions on the hub, or by rotating the tire 180 degrees on the wheel. If run out is still over specification, check wheel run out and mark the low point. Rotate to match the high point of the assembly run out with the wheel low point. If the assembly run out is still too high and the wheel is within specification, replace the tire.
- Lateral run out: Achieved by using a run out gauge to check both the tire and wheel. Chalk mark the highest point of run out on both the wheel and tire. Replace whichever (wheel, tire, or both) is out of specification.

### **VIBRATION DIAGNOSIS**

1. Visually inspect tires, wheels/rims, and vehicle for irregular wear, damaged wheels/rims, or vehicle component damage. Replace or adjust as required. Check wheel mounting to hub, adjust lug nut torque to vehicle manufacture specification.
2. Check to be certain tires are inflated according to vehicle manufacturer recommendations and the vehicle suspension is working correctly and vehicle is not tilting.
3. Check for proper tire mounting on the wheel/rim. The tire fitting line should be concentric with the rim flange. The yellow or red mark on the tire should be oriented to the rim correctly, read our TSB on match mounting.
4. Test drive vehicle on a smooth road surface and diagnose symptoms. Five to ten mile warm up is recommended to remove any flat spotting. Steering wheel vibration diagnosis should begin with front axle, wheel, and tire conditions. Floor or seat vibration diagnosis should begin with rear axle, wheel, and tire conditions. Power train and brake conditions can be diagnosed by alternate brake application and transmission being placed in neutral during vibration.
5. Check tire wheel/rim assembly balance. Adjust as required. If unable to balance, completely deflate tire, unseat tire beads, and rotate tire 180 degrees on the wheel/rim. Rebalance tire and wheel/rim assembly and test drive vehicle.
6. If vibration is not eliminated, measure tire and wheel/rim assembly for excessive lateral or radial run out. Replace as required. Rebalance tire and wheel/rim assembly and test drive vehicle. Some tire balance equipment now allows step 5 and 6 to be performed at the same time, matching of the tire to the wheel, and optimize tire placement on vehicles, consult your equipment providers.

### **BALANCING GUIDELINES**

1. Equipment used to balance a tire and wheel/rim assembly must be accurate, well calibrated and professionally operated. If the tire balancer tolerance is not within 1/8 ounce (3.5 grams) or less, it must be calibrated.
2. To aid in proper balancing, new Yokohama tires have a yellow mark (point of lightest weight) and/or a red mark (point of maximum radial force) on the serial number sidewall. Read our TSB on match mounting to understand the correct orientation of the dot to the rim for best balancing results.
3. Clean deposits of foreign materials from the inside of the wheel/rim. Remove any stones from the tire tread to avoid operator injury and obtain a good balance.
4. Carefully follow the balancer manufacturer's instructions for proper mounting techniques on different types of wheels.
5. Use coated weights on aluminum wheels/rims to prevent damage to the finish.

Additional assistance can be obtained by contacting your local Yokohama Sales Representative, or by calling Technical Services at (800) 423-4544.

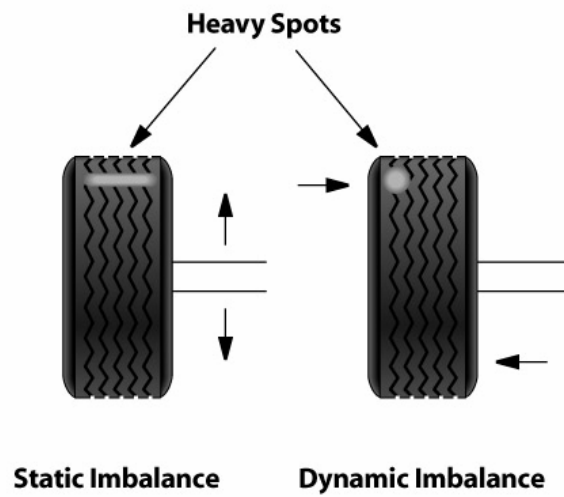


Figure 1 Imbalance Types

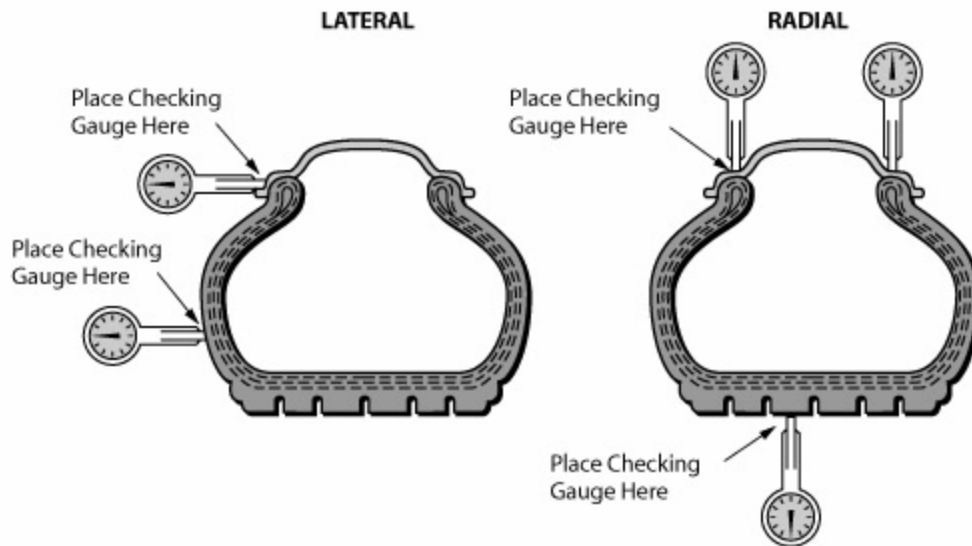


Figure 2 Run Out Checking Locations