Irregular Running and Its Causes

Imbalance

An imbalance usually manifests itself as irregular running and vibration through the entire vehicle or in the steering wheel. It often occurs only in certain speed ranges. If vibration also occurs when the engine is disengaged and in certain gears, we can assume that the wheels and tyres are the cause.

An imbalanced wheel can be seen as being a perfectly even wheel assembly which has an extra weight at one point.

The imbalance comes about through an uneven distribution of the mass. One talks of either a static or a dynamic imbalance, depending on the particular distribution that prevails.

With a **static imbalance** , the weight in the wheel assembly is not distributed evenly. If a segment of the circle is heavier than the others, this would rotate a freely rotatable wheel until the heaviest segment is at the bottom.

This, however, is not the actual cause of the irregular running characteristics. This is caused by the fact that centrifugal forces act on all the segments when the wheel is rotating . These forces are greater the heavier the particular segment of the circle is.

When the mass is distributed evenly throughout the wheel assembly, the centrifugal forces active on opposite sides of the wheel cancel each other out, which means that the wheel axle is not moved out of its normal position. An uneven distribution of mass, however, causes an uneven distribution of the centrifugal forces. These forces no longer cancel each other out and consequently cause the elastically mounted wheel axle to oscillate.

Even if a wheel assembly is not suffering from a static imbalance, it can start to run irregularly as soon as it is set in rotation. This irregular running (e.g. vibration in the steering wheel) can in this case stem from a **dynamic imbalance** .

To be able to draw up a picture of a dynamic imbalance, imagine the wheel cut through vertically in the middle. The cause of the irregular running is an uneven distribution of mass in the front and rear halves of the wheel. These variations do in fact cancel each other out in the sense of a static imbalance, i.e. the centrifugal forces are of equal strength, but they do not act upon the same point in the axle. They therefore set the axle into a wobbling motion.

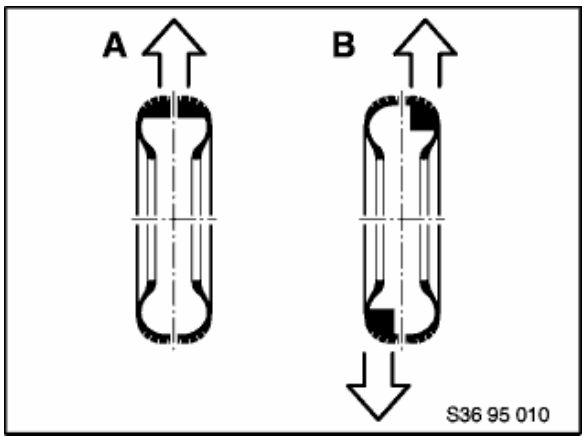
A dynamic imbalance becomes particulary apparent if wide tyres are fitted. This is why wide tyres must be balanced with great care.

Static and dynamic imbalance generally arise together and their causes will be found in both the tyre and the wheel.

If an imbalance is detected, note the speed range in which it arises. The following rule applies for BMW vehicles:

Vehicle speed =	80 - 100 km/h	Front axle affected
Vehicle speed =	140 - 160 km/h	Rear axle affected

An imbalance in a wheel assembly cannot be removed, since it is caused by different distributions of mass in the disk wheel and tyre. The imbalance can, however, be compensated for by attaching a balance weight at the appropriate point.



A Static imbalance

B Dynamic imbalance

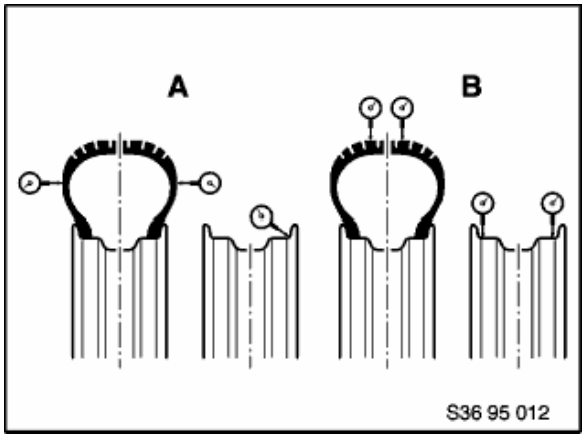
Other causes of irregular running

If a customer still complains of irregular running (e.g. vibration in the steering wheel) after balancing, this may be caused by a wheel running out of true. This is caused by **variations in the production** of tyres and wheels, which have the effect that the wheel assembly deviates from the ideal circular form.

In the case of **radial run-out** , the height of the axle changes constantly as the wheel rotates on the road.

In the case of **lateral run-out** , the wheel wobbles.

Radial and lateral run-out can be determined on the balancing machine. The well centred wheel assembly runs on a dial gauge. The radial run-out is measured by scanning the contact area, while for the lateral run-out the sidewall is scanned. During measurement, attention must be paid to the tread grooves and markings on the sidewall.



A Lateral run-out

B Radial run-out

The cause of radial and/or lateral run-out may be found in the tyre or in the disk wheel. Radial run-out and lateral run-out of a disk wheel are measured at the rim bead seat and inner flank of the rim flange.

The permissible radial run-out must not be exceeded:

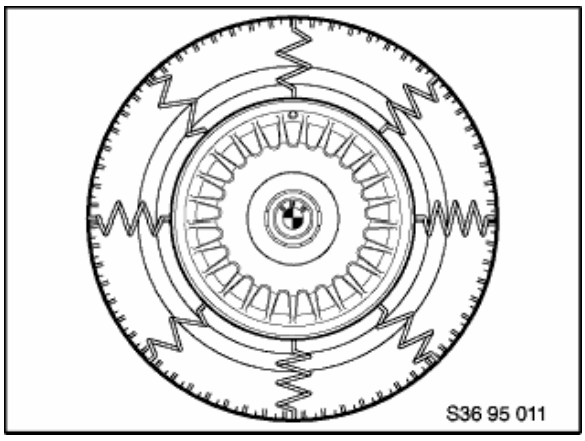
Lateral and radial run-out	- alloy	up to 0.6 mm
	- steel	up to 0.8 mm
Radial run-out of wheel assembly at tyre		up to 1.0 mm

The influence the lateral run-out has on vehicle handling is considerably less than that of the radial run-out.

Another cause of irregular running are **fluctuations in the radial force** . As it rolls, the tyre is pressed in by the weight of the vehicle. A measure of this is the radial force.

Variations in the constitution of the materials cannot be eliminated through balancing. They lead to different degrees of compression and thus to untrue running. Fluctuation of the radial force causes the axle to jump, in the same way as a wheel assembly with radial run-out. The cornering force can also fluctuate (lateral force fluctuation), but the affects of this are only minimal.

These variations cannot be determined with the resources available in a workshop and can only be eliminated by replacing the tyre affected.



Radial force fluctuations

Another cause of irregular running can be **flat spots** on the tyres.

These can arise, e.g. if a vehicle is left standing for a longer period of time (e.g. overnight) to allow the paint to dry after a respray. Temperatures of up to 80° C then occur at the surface of the tyres. These temperatures are reached despite heat shields being placed over the tyres if the vehicle stands long enough in the heated spray cabin. Flat spots develop on the tyres, which cannot be lessened by taking the vehicle for a long drive on the road.

For this reason, a vehicle which has been resprayed should never be left overnight to dry in a warm place. If this cannot be avoided, the vehicle must be placed on chocks and the wheels removed.

In the course of normal respraying work, a temperature of about only 60° C is reached on the tyre surfaces and this is not critical if the vehicle is dried for the normal length of time.

Flat spots can also come about due to the weight of the vehicle if the vehicle is parked immediately after being driven at high speeds without the tyres being given an opportunity to cool down somewhat.

A flat spot can be returned to its original shape by taking the vehicle for a quiet drive, warming up the tyre and then letting it cool down.