AURTTJ011

BALANCE WHEELS AND TYRES

RESOURCE BOOK

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1.1 RUN-OUT

Trueness or run-out, can vary in two dimensions. *Radial* run-out is the variation in trueness around the circumference of a wheel or tyre. *Lateral* run-out is the variation in trueness in a side to side direction.

The most probable cause of bounce problems are tyres and wheels which exceed run-out limitations, and wheels and brake drums which are out of balance. Wheel wobble or bounce can also be caused by loose front end components such as worn ball joints, kingpins, steering linkages.

If you can rotate an object around its centre of gravity you can balance it, so a square block or a hexagon or an octagon can be balanced. Likewise, a tyre with a bulge or a flat spot can be balanced. But balancing will not correct poor ride characteristics of such a tyre.

Before checking run-out, inspect the wheels and tyres for impact cuts, cupping, and poor recapping or bent wheels or rims. If damage is severe, replace the tyre, wheel or both. Also check wheel bearing end play.

Figure 1.1. Checking wheel bearing end play.

To check run out first torque the wheel nuts to shop manual specifications, then using a tyre run-out gauge, check the lateral and radial run-out of the rims and the tyres.

Run-out can be checked by rotating the tyre whilst holding a piece of chalk steadily near the tyre, as shown here in Figure 1.2.

Figure 1.2. Using chalk to check radial run-out.

A more accurate method of determining wheel run-out is to use a dial indicator.

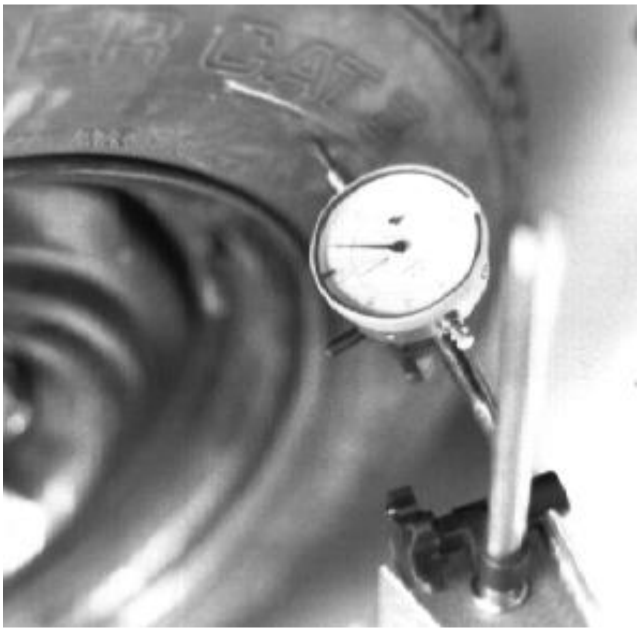


Figure 1.3. Using a dial indicator to check lateral run-out.

If the total radial run-out is over the ***3mm limit***, the cause of the runout needs to be identified. Is it the tyre or the rim? Re-test the runout by checking the rim. Should runout be apparent on the rim then that is where the problem lies. It would be a fair assumption that the tyre is O/K. If the rim is O/K then the problem lies with the tyre.

If the rim has a runout exceeding specifications (approx' 1mm), remove the wheel, clean the mating surfaces, reinstall the wheel and re-check lateral run-out.

If the run-out is still out of specification rotate the wheel with respect to the drum then re check again. Should this fail, it is likely the rim is faulty. This can be confirmed by fitting the spare wheel and re-checking.

Where the tyre is causing the runout, deflate the tyre and break it loose from the rim. Then soap the rims and slide the tyre around until the high radial point on the tyre is matched with the low radial point on the rim. Then inflate the tyre and re check the radial run-out.

If this does not bring the total run-out within limits for radial and lateral run-out, the tyre may have to be trued using a special machine. The machine actually removes rubber from the tyre, while it is mounted on the vehicle to bring it back into round. It would be common to replace the tyre.

1.2 THEORY OF BALANCE

Balance refers to the distribution of the mass of a component around its various centre-lines.

Modern vehicle designs with light weight suspension components and wider wheel sizes all increase the tendency of any out-of-balance that may exist to lead to vibrations noticeable to the driver. Older vehicles with heavier components and narrow wheels were more tolerant to out-of balance situations.

There are a number of types of balance applicable to all rotating parts of vehicles not just wheels.

1.2.A STATIC BALANCE

Static balance refers to the equal distribution of the mass of a component around its axis of rotation.

In Figure 1.4, there is a heavy mass on one part of the component. This heavy mass would cause the component to rotate until the heavy spot is at the lowest point. If operated whilst in this imbalanced state, the greater centrifugal force produced by the uneven mass around the axis of rotation would cause vibration of the component. This would lead to a bouncing or tramping effect causing abnormal tyre wear.

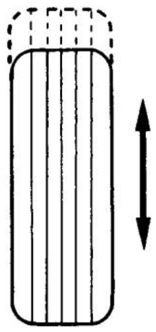


Figure 1.4.

By placing an equal mass at a point 180 degrees opposite, the effect of the imbalance is equalised.

Note: Once the amount of 'out of balance' weight is determined, half of the weight is placed on each side of the rim to prevent creating a dynamic imbalance (covered next).
The component in Figure 1.5 is now "statically" balanced. There is now no tendency for the component to stop in any particular position

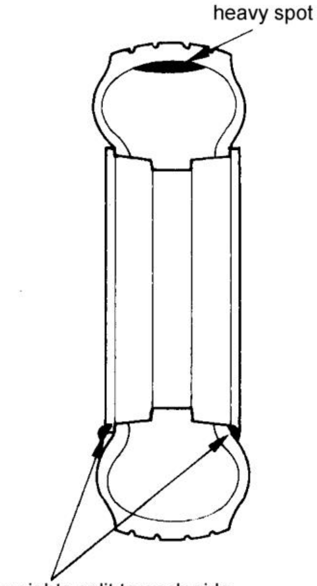


Figure 1.5. Weights have been added to create a static balance.

1.2.B DYNAMIC BALANCE.

Dynamic balance refers to the equal distribution of the mass of a component around a centerline perpendicular to the axis of rotation.

As the wheel in Figure 1.6 rotates, the unequal masses *on the side* of the perpendicular centre of the wheel attempts to move to a position at 90 degrees to the axis of rotation. This produces a "rocking/wobble effect". This is commonly referred to as 'shimmy' as the steering wheel is 'shimmying' from side to side. The further the mass is from the center line of the component (the wider the wheel), the more noticeable the vibration. This means the wider the wheel, the more sensitive it is to dynamic imbalances.

This is the reason that motorbikes and old cars with narrow wheels do not have a problem with dynamic imbalance.

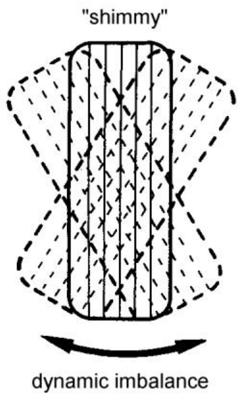
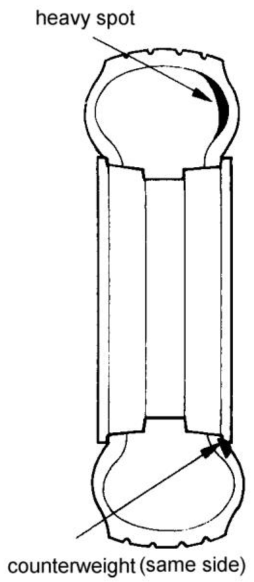


Figure 1.6. The resulting shimmy from dynamic imbalance.



By placing an equal mass in line with the heavy mass (on the same side), the wheel is brought into dynamic balance.

It would be natural at first glance to think that the counterweight would be placed on the opposite side. This would make the problem worse.

Figure1.7. Both static and dynamic balance are achieved

1.2.C IMPULSE BALANCE

It is important to note the amount of static imbalance that exists before beginning to dynamically balance a wheel. If a wheel requires 40 grams or more to bring it in to static balance then the weights required to dynamically balance the wheel will likely be positioned next to each other on either side of the rim. This can affect the impulse balance of the wheel. Impulse balance problems can create vibrations when the direction of the spinning wheel is chanced. To reduce the static balance weight the tyre should be re-fitted 90^0 around on the rim.

1.3 FITTING BALANCE WEIGHTS

Balance weights are shown in Figure 1.8. These have a spring clip which holds them on the rim of the wheel. They are fitted by being tapped into place with a hammer. When properly installed, they fit neatly into the shape of the rim.

Different weights are used for aluminium and steel wheels. Aluminium wheels have a different shape rim to steels wheels, and so the weights need a different cross-section.

Flat weights are also used for aluminium wheels. These have an adhesive which sticks them to the flat part of the rim. It is important to check that any weights positioned on the inside of the rim don't foul any suspension or brake components.

Note: When re-using the old weights, tap the clamping clip closed slightly to ensure a good grip to the rim.

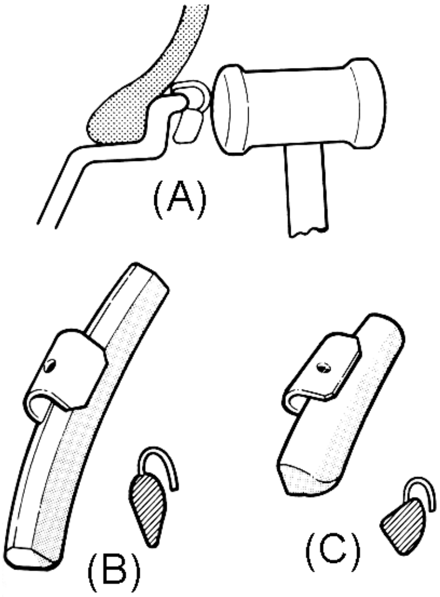


Figure 1.8. Various balance weights:
(A) fitting a weight to a rim
(B) aluminium wheel weight.
(C) Steel wheel weight.

Balance weights are made in a number of different sizes; the mass in grams is shown on the balance weight.

1.4 STATIC BALANCING A WHEEL

To balance a wheel/tyre assembly statically using a bubble balancer

Figure 1.9, the wheel must be clean and free of mud, stones and any wheel weights.

Figure 1.9.

Carefully place the wheel on the balancer, make sure the wheel fits correctly on the center cone as shown in Figure 1.10.

Figure 1.10.

NOTE: The machine must be on a flat level surface (concrete floor).

Operate the foot pedal, this will lift the wheel up a little, see Figure 1.11.

Figure 1.11.

Watch the bubble and wait until it stops moving.

If the bubble is not in the middle, place a weight at the edge of the rim in line with bubble's direction of movement. This is shown in Figure 1.12.

Figure 1.12

Add to or take away from the first weight until the bubble is in the middle.

Mark the tyre with chalk, where the weight is to be fitted as in Figure 1.13.

Find two (2) equal weights that together are the same weight as the first one.

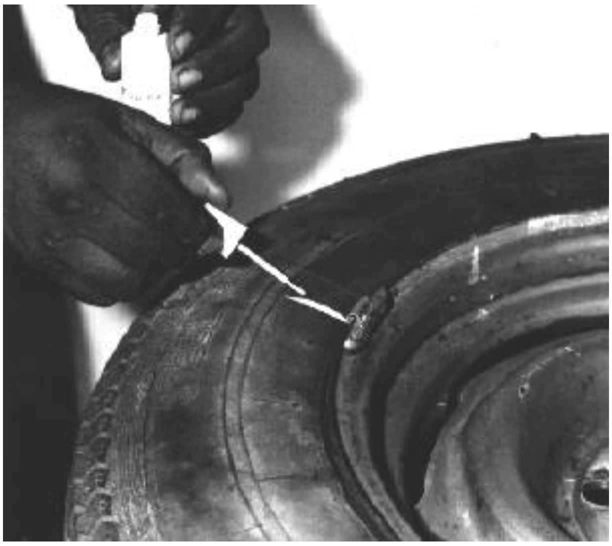


Figure 1.13.

Remove the wheel from the balancer.

Figure 1.14.

Put one weight on the outside of the rim where the chalk mark is.

Put the other weight on the inside of the rim in a line with the first weight.

Figure 1.15.

Recheck the balance again on the machine; the bubble should be in the middle.

If so, the wheel is now in static balance.

Figure 1.16.

If it is not then repeat the steps until it is right.

Many electronic wheel balancing machines will have a function to determine static balance. Check the operating manual of the machine in your workplace to determine if it will calculate static balance.

1.5 DYNAMIC BALANCING A WHEEL

All dynamic balancing is done by machine. Fig 1.17 and 1.18 show two machines that have been used over the years. The 'on vehicle' machine has been largely replaced by the 'off vehicle' machine.

The 'on vehicle' balancer has the advantage of balancing the hub and wheel as a unit however it takes longer to use and is not as technically advanced as modern 'off vehicle' machines.

The following procedure gives a general overview of the operations required to carry out an electronic balance. You need to check with your supervisor as to the specific procedure for the machine in your workplace.

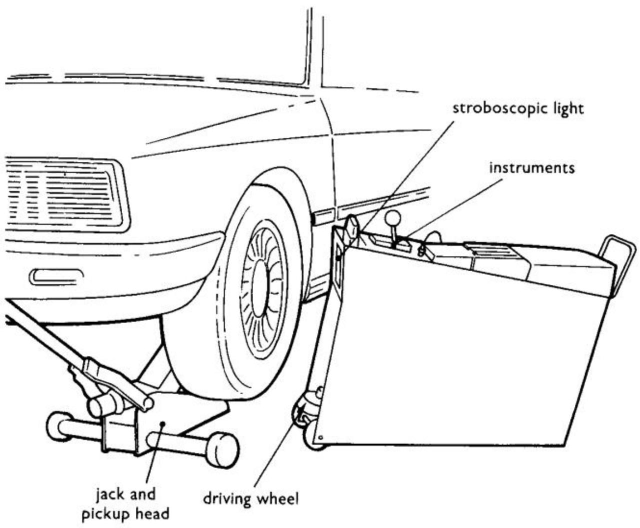
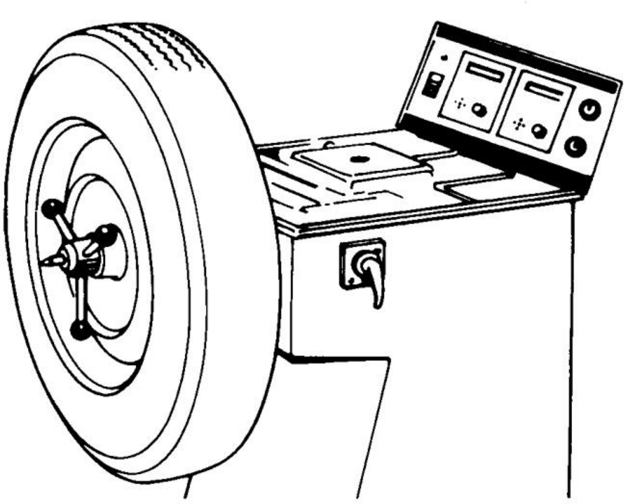


Fig 1.17 'On vehicle' wheel balancer.



The first step to using a dynamic balancing machine is to remove stones, mud and any wheel weights from the wheel as shown in Figure 1.19. The inside of the rim and the hub on the vehicle need also to be checked for dirt or rust/scale.

Fig 1.18 'Off vehicle' wheel balancer.

If rust scale is not removed and becomes trapped between the wheel and the balancing machine the accuracy of the final balance will be affected. If rust scale is trapped between the wheel and the hub of the vehicle, the customer is likely to complain of vibration.

Fig 1.19

Select and fit the correct size centering cone and tighten the quick action clamp as in Figure 1.20.

Care needs to be taken when placing the wheel on the balancer.

Figure 1.20.

NOTE: DO NOT drop the wheel on the spindle shaft.

Set the distance that the rim is positioned from the balancer.
This measurement is taken across the outer and inner flanges as shown in Figure 1.21.

Using the caliper provided, check the rim width and set the machine accordingly.

Figure 1.21.

Set the distance that the rim is positioned from the balancer.

Adjust the rim diameter setting to the correct position for the wheel being balanced.

Figure 1.22.

Lower the safety shield and start the machine. Once the wheel has reached operating speed, the machine will record the amount of weight required and stop the wheel.

Rotate the wheel by hand to the place where the weight has to be attached.

Figure 1.23.

Hold the wheel in the correct position as shown in Figure 1.24 and carefully tap on the weight required.

Restart the machine and check the balance.

Figure 1.24.

Remove the wheel from the balancer.

Figure 1.25

1.6 CALIBRATION

If the balancer in your workplace is old, used a lot, or neglected it may be out of calibration. This will mean that the wheel is likely to be out of balance after the balancing process has been carried out.

There are a couple of quick checks that can be carried out to check the calibration of the machine, they are :

Place the spring, cone, or any other hardware used to secure wheels to the balancer and attach it all with the quick action lock nut. Spin the assembly up and check for balance. Obviously the reading should be zero-zero.

Balance a wheel correctly, and then without removing the wheel from the machine add a weight of say 50g to one side of the wheel. Rebalancing the wheel should now show that a 50g weight is required at a point on the rim 180^0 from the weight you added.

If either of these checks shows a variation of 5 grams or more then there is a problem that requires urgent attention.

