Suspension spring

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Function

Suspension springs are the link between wheels and car body.

Their primary task is to compensate uneven road surfaces and thus provide an assurance of high levels of ride comfort. Secondly, they must ensure that the wheels always have safe contact with the road regardless of its condition. Reliable transmission of drive, braking and transverse forces relies on these requirements being met. As such, suspension springs are one of the most safety-critical components of modern vehicles. They affect handling, roadholding and braking performance.

Linear and progressive spring rate

From the point of view of design, there are suspension springs with linear and progressive spring rate. With linear springs, the spring force increases in proportion with the extent to which they are squeezed together. Progressive springs start with a soft characteristic curve and become harder the further they travel.

Types of suspension springs

The following types of spring are primarily used in today's cars:

Cylindrical suspension springs

These are conventional cylindrical suspension springs with a linear spring rate.

Inconstant wire suspension springs

With this type of spring, the diameter of the wire used decreases towards the end of the suspension spring. Assuming normal road conditions and normal load, the soft ends of the spring can be relied upon for very comfortable ride properties. As well as improving ride comfort, this relieves the load on the wheel suspension as a whole and all steering components.

Mini-block springs

Mini-block springs are barrel-shaped. They are manufactured from tapered wire. This means that they generate a progressive spring rate. The design of the ends of the springs avoids direct contact from winding to winding.

The main feature of the mini-block springs, which were developed from inconstant wire during the 1970, is that when under load, the windings of the ends intertwine without touching. When the ends of the mini-block springs are squeezed together and lie flat on the spring cups (which usually consist of a rubber block), the number of active windings drops and the spring rate increases.

Banana-shaped side load springs

This type of spring controls force distribution for the entire wheel suspension, reducing the friction between the shock absorber piston rod and its gasket. This helps to improve shock absorber response characteristics.

Structure of suspension springs

Depending on the vehicle manufacturer's specification, suspension springs are manufactured from constant wire (same wire diameter across entire spring length) or inconstant wire (varying wire diameter across spring length).

Where inconstant wire springs are concerned, it is said that there are two springs in one: one soft and the other strong. Progressive mini-block springs, for example, offer high levels of ride comfort at low vehicle load and low compression at full load. The spring is therefore "soft" at low vehicle load and "strong" at full load.

Safety

Quality suspension springs make a significant contribution to increased safety, in particular if vehicle loads are high, road surface quality is poor and weather conditions are bad.

Where inconstant wire springs are concerned, a higher load (whether due to vehicle occupancy or poor road surface quality) activates the stronger part of the spring. As a result, the spring generally becomes stiffer. This progressive rise in spring rate gives the vehicle stable roadholding characteristics. There are also two more positive side-effects:

- Banging or squeaking of the springs under load is avoided and
- the surface coating – the key to the springs' long service life – sustains no damage.

Depreciation

Suspension springs from well-known suppliers are delivered with optimum protection against corrosion and damage ex-works. For example, plastic hoses at the ends of suspension springs prevent irreparable surface damage (preventing rust from taking hold) and safeguard quiet and smooth operation. Furthermore, today's design stops contact between the windings, thereby protecting the springs.

Under normal operating conditions, suspension springs will last the lifetime of a car and do not require any particular care. However, they should undergo visual inspection when wheels are changed and during service work. In the event of visible damage to a spring (a tear or a fracture, for example), a replacement must be fitted by a garage.

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