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- Reasons for spring failure & how to detect likely future failure during MOT test
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Spring-production started in Lesjofors, Sweden 1852

13 production plants in Sweden, Denmark, Finland, England, Latvia and China.

Partly owned plant for Gas springs manufacturing in Korea

Sales companies in Sweden, Norway, Finland, Germany, Netherlands and United Kingdom

730 employees
5 product areas

- Automotive aftermarket springs
  - coil, leaf, gas and sports kits
- Wire springs and wire forms
- Medical springs
- Strip components-pressings
- Gas springs for industrial applications
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Suspension basics

- A spring is a mechanical means of storing energy.

- Leonardo da Vinci (1452-1519) discovered the unique properties of the spring defining it as:
  - 'A mechanical element with a number of properties, among them the ability to store energy.’

- On a car the stored energy is equal to the weight of the car.

  - Supporting the car at a height determined by the vehicle designer.
Suspension basics

- The energy absorbed during compression is immediately released by the spring decompressing
  - Some energy is reabsorbed and again released
    - This continues until the energy is dissipated (as heat) and the vehicle regains its stable position

- Springs are in fact Shock Absorbers
  - They absorb energy created by the forces encountered during driving, and support the body of the car evenly by compressing and rebounding with every up-and-down movement.

- Damping devices - Shock Absorbers control this oscillation
Car Suspension

Rear

Suspension springs are part of the total chassis system, wheels included

Front
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Break to view video
Content

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Coil spring manufacturing

- The main stages of Chassis Spring production are
  - Spring Forming (coiling)
  - Heat Treatment
  - Grinding
  - Shot peening
  - Pre setting and testing
  - Zinc phosphating
  - Painting - by electrostatics
  - Identification (part numbering) by ink jet printing
The wire is cold formed (Cold Coiling) to spring shape using computer controlled automatic coiling machines and computer controlled mandrel coiling machines.

Above a certain thickness computer controlled hot coiling machines are also used.

The method used depends on the Spring dimensions, design and the quantity to be manufactured.
Heat treatment is required for every Chassis Spring and essentially involves

- **Tempering**
  - The initial heating resulting in a hard and rather brittle material

- **Quenching**
  - A cooling process

- **Annealing**
  - Further heating to soften the spring and make it more ductile or spring like
All ROC chassis springs are shot peened.

Shot peening is a treatment where all surface parts of the spring are bombarded with millions of tiny steel shots.

The treatment improves the fatigue strength of each spring and provides an optimum surface for the paint.
All ROC springs are fully compressed and tested before leaving the factory.

The pre-setting operation, among other things, helps to improve the fatigue strength of each spring.
All springs are protected from corrosion by zinc phosphate and epoxy powder resin paint.

This technique gives excellent protection against corrosion, even if there is a scratch in the paint surface.
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Important spring design aspects:

- Ride height - spring length at axle load
- Kerb weight - The force (N) that each spring is exposed to when the vehicle is unloaded and parked
- Spring rate / load and deflection diagram
Design

More important spring design aspects:
- Free length and rebound length
- Block length and bump length
Design

More important spring design aspects:
- End seats shape and geometric movement
- Spring dimensions and weight
Coil Spring Design

- The spring must mechanically fit in the suspension system
- The free length of the spring must be greater than the rebound length (the maximum possible opening between spring mounts)

If free length is less than rebound the spring can fall out from the spring plates when driving over bumps at high speed.

Free length = Length of the spring when it’s not built into the car

Example of rebound security – the spring length suitably exceeds the maximum opening between end plates
The block length of the spring (maximum compression) must be shorter than the shortest possible distance between spring mounts (bump length).

If the spring is fully compressed before the bump stops are compressed, several suspension parts could be damaged.

The spring length at chassis load must be controlled so the vehicle sits at the correct ride height.

The spring rate should be set to the correct level for greater comfort, performance and safety.
Technical Basics

- Spring rate can be defined as ‘deflection per unit load applied’
  - It is generally measured in the UK in Pounds per inch (lbs/inch) and in Newton per metre (N/m) throughout Europe
- Spring rate can be divided into
  - Linear Spring rate and
  - Progressive Spring rate
Technical Basics

- Linear Spring rate is when a coil spring has the same strength throughout its length. Rate is consistent.
  
  - for each additional unit of load applied the springs deflection is consistent

- A progressive rate coil spring has a increasing strength throughout its compression.
  
  - for each additional unit of load applied the deflection will reduce
Concerning spring rate, the material type is not the only influencing factor. Essentially there are four key variables to determine spring rate – wire diameter, coil diameter, pitch and coil support from the spring pans.

Minibloc springs, for example, can be designed to have linear or progressive rate by altering these variables, irrespective of whether the material is parallel or tapered.

Miniblocs designed with parallel (normal) wire can have a progressive or linear load and deflection characteristic (spring rate). This is achieved by altering the pitch in collaboration with the external diameter.
The spring shown here is a minibloc spring with a linear spring rate, and the below load diagram shows this graphically.

Miniblocs manufactured from tapered material can also have progressive or linear load and deflection characteristics.

They often have a linear rate however, since the reduced material diameter compensates for the reduction in the spring’s external diameter.
Spring Load

Spring diagram

Spring length (mm) vs Load (N)

- L Rebond
- L Bump
- F kerb

Standard

Load (N)

0 1000 2000 3000 4000 5000 6000 7000 8000

Spring length (mm)

0 50 100 150 200 250 300 350 400 450 500
Design

There are different types of suspension springs:

- Cylindrical with ground or open ends
- Cylindrical with tapered ends
- Mini block
- Conical with ground or open ends

- Centric load axle
- Eccentric load axle
- Inclined load axle

- Ends can have different angles
- End can move in a bow
- End can move in other ways

- Spring can have a linear or progressive load characteristic
Three factors work together to create different spring types

- **Form**
  - *Different body shapes and end styles*

- **Wire**
  - *Parallel or tapered*

- **Rate**
  - *Linear or progressive*
Coil spring design

- Explanation of Spring body shapes
  - $C =$ Cylindrical end
  - $I =$ Pigtailed end
  - $K =$ Conical end
  - $U =$ Widened end
Coil spring design

- Explanation of Spring end Styles
  - Ground end
  - Pigtailed end
  - Open end
  - Squared off end
Cylindrical springs

A cylindrical spring design normally consists of end coils, transition coils and spring coils.

A cylindrical spring can be designed to provide linear rate, or equally designed to give a progressive spring rate by varying the pitch.

Cylindrical springs can also, in the axial direction, be bent in shape. This variant can be of interest when the designer needs to compensate for lateral forces influencing the shock absorber.

An advantage of cylindrical springs is that they can be automatically handled during production.
Conical springs

Conical springs are normally chosen when there are space limitations for the spring in the suspension system.

This type usually has open ends and sometimes one pigtailed end. The springs can be designed with either linear or progressive spring rate.
Minibloc Springs

A real minibloc spring design has coil diameters adjusted so that most of the coils fit inside each other when the spring is compressed to a short length, hence the name minibloc.

This design solution can reduce the bloc length close to two times the material diameter.

The advantage is the very small bloc length of the spring and hence the space saved. This can be of great value in the rear of a car.
Coil spring design

Parallel or Tapered spring wire?

**Tapered**

- Tapered material varies along the springs length and thins out towards the end(s)

**Parallel**

- Parallel material is a consistent thickness throughout the spring’s length
Parallel or Tapered spring wire?

Corrosion attack on the end coils of a spring made from tapered wire will lead to breakage quicker than compared to a spring made using parallel material.

The stress is much lower in a design with end, or transition, coils made from parallel diameter material.

All ROC springs are made using parallel wire.
A corrosion attack at the end coils, on a spring with tapered material carrying high stresses will more quickly lead to breakage compared to a minibloc made from parallel (normal) material.

The reason is that the stress is much lower in the end and transition coils with parallel (normal) wire.

This can be understood by looking at the general formula for stress calculation in springs.

**Basic formula for stress calculation:**

\[ \tau = \frac{(8 \ D)}{(\pi \ d^3)} \times F \]

- Shear stress (\(\tau\)) N/mm²
- Coil diameter (\(D\)) mm
- Pi (\(\pi\))
- Material (wire) diameter (\(d\)) mm
- Load (\(F\)) N
Coil spring design

Examples of stresses at different wire diameters are shown here, and it can clearly be seen that, with the same coil diameter and load, a larger wire diameter gives a lower stress.

**Example 1:**
If \( D = 60 \) mm, \( d = 8.4 \) mm and \( F = 4000 \) N
\[
\tau = \frac{(8 \times 60)}{(\pi \times 8.4^3)} \times 4000 = 1032 \text{ N/mm}^2
\]

**Example 2:**
If \( D = 60 \) mm, \( d = 13 \) mm and \( F = 4000 \) N
\[
\tau = \frac{(8 \times 60)}{(\pi \times 13^3)} \times 4000 = 278 \text{ N/mm}^2
\]

A larger wire diameter gives a lower stress at the same coil diameter and loads.
Coil spring design
rear spring for Renault Clio ’98-

ROC spring v’s OE spring under testing

Spring travel from rebound to bump length

<table>
<thead>
<tr>
<th>Spring length (mm)</th>
<th>Spring load (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>230</td>
<td>2500</td>
</tr>
<tr>
<td>240</td>
<td>2000</td>
</tr>
<tr>
<td>250</td>
<td>1500</td>
</tr>
<tr>
<td>260</td>
<td>1000</td>
</tr>
<tr>
<td>270</td>
<td>500</td>
</tr>
</tbody>
</table>

Kerb weight

ROC reference
OE 8455287
In summary, the key elements are:

- Wire Diameter
- Internal / External Diameter
- Free Length
- Number of Coils
- Body Style
- End Configuration
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SUSPENSION SPRING QUALITY CERTIFICATE

REGULATION
European Commission No. 1400/2002 of 31 July 2002

Suspension springs manufactured and supplied by ROC are classified as Parts of Matching Quality.

Spring calculation, material used, spring manufacturing, anti-corrosion surface treatment, quality and environment assurance are according to OE suspension spring branch standards.
Matching Quality

NORMATIVE REFERENCES:

**Spring calculation**
- EN 13906-1 Cylindrical helical springs made from round wire and bar - Calculation and design
- EN ISO 2162-2 Presentation of data for cylindrical helical compression springs
- ROC Fjäderhandbok 1990

**Material**
- EN 10089:2002 Hot rolled steel for quenched and tempered springs technical delivery specifications.
- EN 10270-2:2001 Oil hardened and tempered spring steel wire.
- ASTM A401 Specification steel wire Chrome-Silicon alloy.
- ASTM A229 Steel wire Oil tempered.
- ASTM A689 Steel bars for springs
- EN 10204:2005 Type of inspection documents.
- EN10021 General technical delivery conditions for steel
- EN10277-1 Bright steel products technical delivery conditions
- ISO 683-14 Hot-rolled steels for quenched and tempered springs
- ISO 8458 part 1 and 3 Steel wire for mechanical springs
Matching Quality

**Spring manufacturing**
- EN 15800:2008 Quality specifications for cold coiled compression springs
- DIN 2096-1 Quality requirements for hot formed springs
- DIN 2096-2 Quality requirements for mass production
- ASTM A125 Specification for steel springs, Helical, Heat treated
- Stress relief heat treatment according to material supplier specifications.
- ISO 26910-1 Springs -- Shot peening -- General procedures
- ROC Standard for Pre-setting.
- SAE J-442, Almen test, Shot Peening

**Surface treatment**
- Volvo Standard 5751.5; Y500-4, Painting class for components of metal exposed for severe corrosive attacks.
- Volvo test methods: Std 1021, Std 1024, Std 1027, Std 1029, Std 3371, Std 5711, Std 5715.
- EN 12476, Zinc phosphate, Method of specifying requirements.
- ISO 9717, Zinc phosphate, Method of specifying requirements.
- ASTM B499 Test method for measurement of coating thickness by the magnetic method
- EN ISO 2808 Paints and varnishes - Determination of film thickness

**Quality and environment assurance**
- ISO 9001:2008, auditor TÜV
- ISO 14001:2004, auditor TÜV
- TÜV Automotive GMBH, Test chassis spring performance.
Matching Quality

- Who would consider selling a safety critical item such as a suspension spring without knowing that it has been properly designed and manufactured and that the manufacturer takes all the liability risk?

- ROC Springs are manufactured to the highest standards to match or exceed OE quality. They are produced to ISO9001 with third party certification from the likes of Volvo.

- A ROC spring can, of course, be used as a viable replacement during the routine servicing of a vehicle, and use of a ROC spring will not invalidate the vehicle manufacturers’ warranty.

- As you may know, and as a general indication of our standing as a spring manufacturer, we supply the likes of Volvo, Saab, Rolls-Royce, Öhlins, Haldex, JCB, Jungheinrich, ABB, Siemens, Atlas Copco, Saab Wabco, Alfa Laval, Philips, Bang & Olufsen, Nokia and Sony Ericsson to name just a few.
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Why are Springs Replaced?

- Even the best made springs become ‘tired’ after many millions of cycles. In time, springs will shorten or sag
  - Ride height is lost
  - Steering is less responsive
  - Caster & Camber angles will change
  - Road holding is less secure
  - Braking distances are lengthened
  - Tyre wear is increased
  - Load carrying capacity is reduced
  - Driver and passenger comfort is reduced
Breakage is however the main reason for Spring replacement!

Breakage is due to either:

- Poor Spring Wire
  - Containing inclusions
- Poor Heat Treatment
  - Causing brittleness
- Poor design
  - Causing over-stressed springs
- Corrosion (perhaps the most critical factor)
  - Rust reduces the cross-section of a spring, weakening it.
Why do coil springs break?

**Reason for breaking**

- **Poor quality spring wire**
  With surface cracks / flakes
  With internal non-metallic inclusions

- **Poor heat treatment**
  Ineffective in removing negative internal stresses caused by coiling

- **Lack of Presetting**
  Likely high sheer stress during compression and increased risk of Breakage

- **Corrosion**
  Paint layers chip, and without protection spring steel will begin to rust immediately - creep corrosion causes rapid spread

**What we do to prevent it**

- ROC only use high grade specialist “spring” steel from selected mills worldwide.

- Every spring is tempered (heated), quenched (cooled) and annealed (heated) at the correct temperatures, and for the appropriate duration, to reduce brittleness.

- Effective use of shot peening and presetting reduce sheer stress and raise spring performance.

- All ROC springs are protected from corrosion by zinc phosphate and epoxy powder paint as required by the most demanding OEMs.
Coil spring failure

Poor quality spring wire

Almost all melting plants today can produce steel with the specified chemical analysis of spring steel, but standards are much more stringent than that. Only a few mills are specialised enough to produce the level of quality needed for modern suspension springs with high stress levels.

ROC use high grade, specialist spring steel with high stress levels.

Quality of the surface material

Cracks, flakes & other surface defects can significantly reduce performance, by lowering spring fatigue strength, leading to premature breakage.
Coil spring failure

**Poor Heat Treatment**

When springs are cold coiled, negative internal stresses are introduced. These must be removed by heat or the chance of failure is increased significantly.

*ROC remove these negative internal stresses by hardening, quenching, tempering & stress relieving the spring after cold coiling.*

After stress relieving, it is important to introduce & control the level of positive residual stress in the spring, as this will reduce shear stress during compression.

*Controlled use of shot peening & presetting ensure high positive residual stress levels within the spring.*
Corrosion

Defects & chips in the layer of lacquer cannot be avoided, and without additional protection the spring steel will begin to rust immediately, leading to creep corrosion which spreads rapidly, significantly increasing the risk of breakage.

ROC provide an additional layer of protection between the paint & the spring by using the galvanic protection method of zinc phosphating.

Suspension spring fatigue breakage initiated by heavy corrosion under the epoxy powder paint layer.

SEM (Scanning Electron Microscope) picture of the ROC Zinc Phosphate layer, the discs are phosphate crystals giving protection under, and adhesion to, the paint layer. Picture taken before paint application.
Coil spring failure

This provides protection from corrosion even after defects occur in the paint layer, and is significantly more effective at preventing corrosion than other phosphating methods.
## Failures by defect category as a percentage of vehicles tested at MOT stations

**Cars & light vans up to 3000kg**

<table>
<thead>
<tr>
<th></th>
<th>2008/09 % of tests</th>
<th>2008/09 % of defects</th>
<th>2007/08 % of tests</th>
<th>2007/08 % of defects</th>
<th>2006/07 % of tests</th>
<th>2006/07 % of defects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting &amp; Signalling</td>
<td>18.9%</td>
<td>23.8%</td>
<td>18.8%</td>
<td>23.7%</td>
<td>18.2%</td>
<td>23.2%</td>
</tr>
<tr>
<td>Brakes</td>
<td>17.1%</td>
<td>21.5%</td>
<td>17.4%</td>
<td>22.0%</td>
<td>17.8%</td>
<td>22.7%</td>
</tr>
<tr>
<td>Suspension</td>
<td>12.2%</td>
<td>15.3%</td>
<td>11.9%</td>
<td>14.9%</td>
<td>12.0%</td>
<td>15.2%</td>
</tr>
<tr>
<td>Body</td>
<td>8.6%</td>
<td>10.8%</td>
<td>8.4%</td>
<td>10.5%</td>
<td>8.0%</td>
<td>10.1%</td>
</tr>
<tr>
<td>Tyres</td>
<td>8.1%</td>
<td>10.2%</td>
<td>7.9%</td>
<td>10.0%</td>
<td>7.5%</td>
<td>9.6%</td>
</tr>
<tr>
<td>Fuel &amp; Emissions</td>
<td>6.7%</td>
<td>8.4%</td>
<td>7.0%</td>
<td>8.9%</td>
<td>7.1%</td>
<td>9.0%</td>
</tr>
<tr>
<td>Steering</td>
<td>2.7%</td>
<td>3.4%</td>
<td>2.7%</td>
<td>3.4%</td>
<td>2.7%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Structure</td>
<td>2.3%</td>
<td>2.8%</td>
<td>2.3%</td>
<td>2.9%</td>
<td>2.4%</td>
<td>3.1%</td>
</tr>
<tr>
<td>Seat Belts</td>
<td>1.8%</td>
<td>2.2%</td>
<td>1.7%</td>
<td>2.2%</td>
<td>1.8%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Other</td>
<td>0.9%</td>
<td>1.1%</td>
<td>0.9%</td>
<td>1.2%</td>
<td>0.9%</td>
<td>1.1%</td>
</tr>
<tr>
<td>Road Wheels</td>
<td>0.3%</td>
<td>0.4%</td>
<td>0.3%</td>
<td>0.4%</td>
<td>0.3%</td>
<td>0.4%</td>
</tr>
</tbody>
</table>

**Overall Failure Rate** 36.3%

**Defects Per Failed Test** 2.19

---

**Notes:**
A failed vehicle often has more than one failure item.
The % of tests shows the percentage of the defect category against the total number of tests carried out.
The % of defects shows the percentage of the defect category against the total number of defects found from all tests carried out.
Whilst we are not aware of the precise split of these figures; the occurrence of spring failure is increasing significantly, whilst shock absorber failure is steadily reducing.

Additionally, spring examination would lead to many more failures, were it not for the MOT test being a relatively blunt tool (specific to springs).

The following shows the test criteria specific to suspension springs.
## 2.4 Suspension - General

### Information

**Shortened or lowered coil springs**

Take care when jacking vehicles with shortened or lowered springs fitted. Provided the spring ends locate correctly when the vehicle is lowered into the normal running position, without assistance this is not a reason for rejection.

### Method of Inspection

<table>
<thead>
<tr>
<th>C. <strong>Coil Springs</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Examine each coil spring for general condition. In particular, look for cracks or fractures.</td>
</tr>
<tr>
<td>2. Check that both ends of the spring are correctly located.</td>
</tr>
<tr>
<td>3. Check that the spring mountings are</td>
</tr>
<tr>
<td>a. Secure</td>
</tr>
<tr>
<td>b. free from cracks and fractures</td>
</tr>
<tr>
<td>c. free from excessive damage or corrosion.</td>
</tr>
</tbody>
</table>

### Reason for Rejection

1. A coil spring
   a. incomplete, cracked or fractured
   b. worn or corroded so its cross sectional area is reduced such that it is seriously weakened
   c. repaired by welding or damaged by excessive heat.
2. A coil spring not correctly located.
3. A coil spring mounting
   a. Loose
   b. cracked or fractured
   c. seriously weakened by damage or corrosion.
### Method of Inspection

A. **All Suspension Types**

1. Check
   - that there is enough clearance of the axle or suspension with the bump stop or chassis, and
   - whether any suspension unit is so weak that it does not hold the body far enough away from the road wheels.

2. Examine the vehicle structure around any sub-frame, spring or suspension component mounting for:
   - excessive corrosion (i.e. within the 'prescribed area', see Appendix C)
   - distortion
   - fractures

   **Note:** It is usually necessary to open the bonnet to inspect front suspension components. It may be necessary to inspect the inside of a luggage compartment or boot to effectively check prescribed areas and testable items that otherwise would not be seen.

### Reason for Rejection

1. **Inadequate clearance of the axle or suspension with the bump stop or chassis, or**
2. **Deliberate modification which significantly reduces the original strength**, excessive corrosion, severe distortion, a fracture or an inadequate repair of a load bearing member or its supporting structure or supporting paneling within 30cm of any sub-frame, spring or a suspension component mounting, that is, within a 'prescribed area', see Appendix C.
How to detect likely future failure during MOT test

The areas reviewed under the MOT test will clearly indicate whether the vehicle should fail the test.

Additionally, whilst problems may not be sufficient for failure at point of inspection, likely failure may clearly be expected from:

- **Reduced ride height (due to sag) or an imbalance in ride height across an axle**
- **Excessive rust, particularly on the end or transition coils**
- **Salt/grit/water build up within spring mount, and deterioration of spring mount**
- **Chips or scratches to the spring’s surface and/or clear evidence of creep corrosion**
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Fitting coil springs

Fitment Advice

- Always use an appropriate spring compression tool when replacing coil springs
- Check the condition of the spring mounts before replacing springs; clean out any road debris before installation
- Always ensure the spring sits correctly in the mounts
- If a spring is more closely coiled at one end, it is recommended to install with that end to the top. This will reduce road debris building up between the coils within the lower spring pan
- Once the installation is complete, it is advisable to check all suspension geometry
Coil springs

Always replace springs in pairs

With use, springs will shorten (or sag) from their original length over time.

If only one spring is replaced the following may occur...

- Ride height imbalance on the same axle
- Steering is less responsive
- Road holding is less secure
- Braking distances are increased
- Tyre wear is increased
- Fuel efficiency reduced
- Load carrying capacity is reduced
Always replace springs in pairs

**So why don’t some workshops?**

- **Time**
  - Front springs generally take more time to replace compared to the rear, as there are usually more suspension components to remove and they are often more difficult to access.

- **Cost**
  - Workshops compete with each other for repair work of course, and some will quote for a single repair to get the job rather than quote for a pair.

- **Sales arguments**
  - Some Workshop personnel are not equipped with the sales arguments to “sell” a pair of springs
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Future technology

Air Springs

- Some car manufacturers are introducing air springs in their suspension systems
- These systems; comprising of a rubber tube, require compressed air supply, and a control system for the pressure & air flow
**Future technology**

- **Air Springs**

  The relatively high costs for the compressor, tubing, valves and controls system have lead to this technology only being used on expensive models to date.

  Coil springs, with a controlled shock absorber system, give the same road performance except for the vehicle height adjustment possibility.
Future trends

- **Air Suspension Components**

  The bump stops (the microcellular elastomers), especially in the rear, are made larger and are used more to add load on a longer length of the deflection.

  This makes it possible to reduce the weight of the springs.

  Since the load is lower, the stress in the material is also lower and hence it is possible to use a smaller diameter material without reducing the sag and fatigue properties.
Materials

Some OE manufacturers are looking at increasing the ultimate tensile strength (hardness) of the spring material in order to reduce the overall spring weight, without increasing the sag/creep performance.

The weight reduction, mostly achieved by a reduction of the material diameter, increases the stresses in the material.

This higher tensile strength reduces the toughness however, in equal measure to the increased brittleness of the steel.

**The combination of higher stresses and lower toughness makes the springs more sensitive to surface and structural defects**
- defects cannot be completely avoided by the steel suppliers

**It also make the springs more sensitive to corrosion**
- the demand to protect the steel surface becomes more important

The risk for fatigue breakages will increase if the material quality and the surface protection are not improved.
Future trends

- **Spring Design**

“Banana” shaped springs are being increasingly used for Macpherson strut assemblies. The bent shape reduces the lateral loads on the shock absorber, bearings and seals.

This is still classed as a cylindrical spring; but bent in the axial direction.

Suspension springs with ground ends are seldom designed today due to the high cost of grinding.
Future trends

- **Spring Design**

The car industry is exerting pressure on spring manufacturers to produce lighter weight springs at lower prices.

Most spring performance, in relation to the cost, is achieved with cylindrical springs with open, unground ends, made from parallel wire.

Opening the end coils adds deflection to the design and therefore helps achieve more energy per Kg of spring material.
Content

- Brief overview of group
- Suspension basics
- Video
- Manufacture methods
- Coil Spring design / changes in design & why more coil springs break now than ever before
- Matching Quality
- Reasons for spring failure & how to detect likely future failure during MOT test
- Correct fitment & fitting in pairs
- Future technology & trends
- **Other product areas**
- Quiz – followed by any questions
Leaf springs

Leaf springs were common on vehicles up to the 1970’s; when the move to front wheel drive, and more sophisticated suspension designs saw vehicle manufacturers move to coil springs instead.

Leaf springs are however still used on HGV and LCV, 4WD and SUV’s. The advantage over coil springs being higher load carrying capacity and the benefit of spreading the load more widely over the vehicle’s chassis

**U-Bolts** (pair)
- Clamp leaf spring to the axle
- Usually replaced with every leaf spring

**Shackles**
- Connect spring to chassis
- Allows for movement of spring during compression
Leaf springs

- Over 250 parabolic and multi-leaf options for light commercial, 4x4 vehicles and utility pick-ups
- Supplied fully bushed
  - Dealer springs usually supplied without
- All parts are available from stock
- U-bolts available for all applications
- Traditional dealer product
Leaf springs

Parabolic spring

- Modern design – lighter than multi-leaf
- Fewer leaves of varying thickness from centre to ends than multi-leaf spring
- Only contact between the leaves at the ends and the centre
- Offers improved ride quality and more efficient use of material
Leaf springs

Multi-Leaf Spring

- Number of leaves stacked on top of each other
- Auxiliary spring – stops spring becoming inverted during load
- Spreads the load over the axle rather than one point
Gas springs

Gas springs are common on most vehicles and are designed to keep the boot or bonnet from closing naturally.

- Over 1000 boot and bonnet gas springs
- Supplied complete with fittings
- Contain pressurised Nitrogen gas
- Break more in the cold weather
- Always replace in pairs
- Traditional dealer product – therefore aftermarket profit opportunity
Sport springs

- Over 800 parts - safely lower the car by up to 50mm
- Uprated compared to original springs and improves road handling
- Must be changed on both axles (where applicable)
- Designed to be fitted with standard shock absorbers, although ride may be further enhanced with use of gas shocks
- Once the installation is complete, it is advisable to check all suspension geometry
Automotive

- Only UK spring supplier to manufacture all its own products
- Produce the World’s largest range of suspension springs
- 750,000 units stock – giving consistent very high availability
- 100% quality assurance from computer controlled production
- Parts of OE Matching quality according to BER 1400/2002
Content

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- Other product areas
- Quiz – followed by any questions
1. State two reasons why coil springs break?

2. What are the two types of common leaf spring called?

3. What gas is used in the chamber of ROC Gas springs?

4. What can happen to the vehicle if coil springs are not replaced in pairs on the same axle? (two answers required)

5. What is the maximum distance ROC sport springs can lower a vehicle chassis by?

6. How long is the warranty on ROC coil springs?

7. What is the alternative spring material to parallel wire?

8. Why don't workshops always change springs in pairs?
1. State two reasons why coil springs break?
   1. Corrosion
   2. Poor spring wire

2. What are the two types of common leaf spring called?
   1. Parabolic
   2. Multileaf

3. What gas is used in the chamber of ROC Gas springs?
   1. Nitrogen

4. What can happen to the vehicle if coil springs are not replaced in pairs on the same axle? (two answers required)
   1. Increased breaking distance
   2. Increased tyre wear
   3. Reduced handling
   4. Less responsive steering
   5. Vehicle imbalance
   6. Reduced fuel efficiency

5. What is the maximum distance ROC sport springs can lower a vehicle chassis by?
   1. 50mm

6. How long is the warranty on ROC coil springs?
   1. 3 years

7. What is the alternative spring material to parallel wire?
   1. Tapered wire

8. Why don't workshops always change springs in pairs?
   1. Time
   2. Cost
   3. Sales arguments
Thank you for your attention!

Please feel free to ask any questions.