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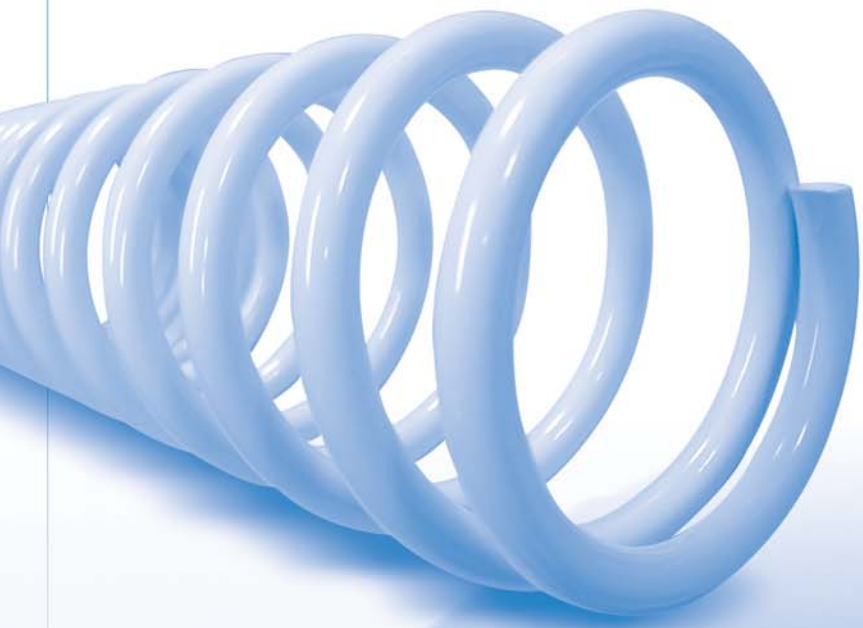
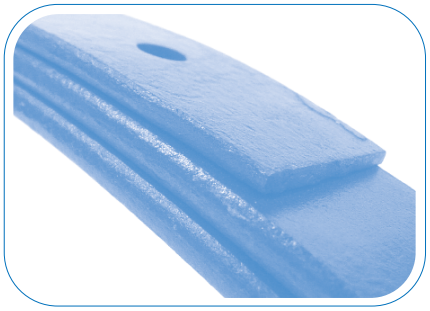
DETROIT SPRING, INC.





SPRING TECH 101

www.eatonsprings.com

SPECIALIZING IN: HOTRODS, RESTORATIONS, AND MODIFIED APPLICATIONS

ABOUT EATON DETROIT SPRING, INC.

Since our founding in 1937, **EATON DETROIT SPRING, INC.** has grown to be the leading manufacturer of springs for the restoration and street rod industries. We are different from all other spring sources, because we actually manufacture springs.

With a library of over 23,000 Original Equipment blueprints and our in-house design and manufacturing teams, we offer what no other spring manufacturer can, the correct spring for your vehicle.

Unlike many other parts of a vehicle, springs are very unique to a vehicle. Many things not even thought about must be considered when determining the correct spring –

- Engine size
- Transmission type
- Air conditioning
- Tire size
- Location of the battery
- Even build date

THERE IS NO SUCH THING AS "ONE SIZE FITS ALL" TYPE SPRING.

Due to the many variations in the way the same vehicle could be offered, the factory installed various versions of the seemingly same suspension. First generation GM F and X Bodies had over 100 different rear springs and 19641/2 through 1973 Mustangs have more than 30 rear springs.

To attempt to replace these variations with one or two replacements springs will not allow the suspension to work, nor will the vehicle handle as it was designed.

Every spring made by **EATON DETROIT SPRING, INC.** is -

- Made to the Original Factory Blue Print of which we have over 23,000
- Made from SAE 5160 High Alloy Spring Steel
- Rolled and Tapered ends
- Shot peened for longer life
- Can be custom built to meet special needs

Moreover, to add just a bit more credibility – **EATON DETROIT SPRING, INC.** has been the only spring manufacturer to be Licensed by both Ford Motor Company and General Motors Restoration Programs.

In addition to Leaf and Coil Springs, we carry a full line of Installation Kits that include bushings, shackles, u-bolts, axle pads etc.

SPRINGS

Springs are the oldest form of suspension known to man. In early times leather straps were used on carriages to provide cushion and stability. As steel manufacturing was perfected during the Industrial Revolution it was discovered that replacing leather straps with steel leaves provided a serious improvement in ride, comfort and life of the suspension. Hence the first steel leaf spring suspension was manufactured. As time passed leaf spring technology improved: coil springs were developed, torsion bars were tried, and now air suspensions are being introduced.

As a steel spring manufacturer since 1937, we have learned a few things about springs and suspensions and believe the more we can share our knowledge with you, the better understanding everyone will have about springs.

CHARACTERISTICS OF A GOOD SUSPENSION INCLUDE -

- Maximum deflection consistent with required stability
- Compatible with other vehicle components in terms of over all ride
- Minimum weight
- Low maintenance and operating costs
- Minimize tire wear
- Minimize wheel hop
- Low initial cost

LEAF AND COIL SPRINGS BY DESIGN PERFORM MANY FUNCTIONS -

- Support the weight of the vehicle
- Provide adequate stability and resistance to side sway and rollover
- Resist cornering effects when negotiating a curve
- Provide cushioning

LEAF SPRINGS ADDITIONALLY ARE DESIGNED TO -

- Connect the axle to the vehicle
- Transfer driving and braking forces between frame and axle
- Resist drive and brake torque, know as wrap up
- On drive axles provide minimum changes in drive axle pinion and limit movement of drive axle slip splines
- On steering axles, they maintain the proper wheel caster and camber.

STEEL USED TO MANUFACTURE SPRINGS

Quality versions of springs are made from High Alloy Spring Steel known as SAE5160. While springs can be made from cheaper low carbon steels they will lack the durability of springs made from SAE5160.

Springs have a memory that allows them to return to the original position time after time. While it is true that over time springs will settle and lose their ability to support weight, springs made from SAE5160 will outlast the others many, many times over offsetting any cost savings.

THERE ARE ONLY 3 BASIC TYPES OF LEAF SPRINGS

Multi-Leaf springs consist of heat-treated flat steel bars of diminishing lengths formed to a predetermined arch held together by a bolt through its center.

Mono-Leaf springs consist of only one heat-treated plate of steel whose thickness is uniformly tapered from the center to each end. A tapered mono-leaf spring can equal or exceed the strength of a multi-leaf spring.

Parabolic springs are multi-leaf versions of Mono-Leaf springs. That is, they consist of 2 or more full tapered leaves.

SPRING EYES

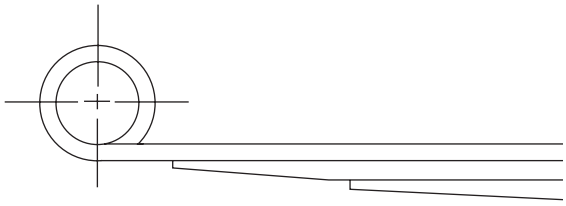
Leaf spring eyes hold the bushings through which bolts or pins pass through to attach the spring to the vehicle. Spring eyes can be Standard, Berlin or Reverse. Each has it's own features.

Standard eyes are the most popular and easiest to make. Main plates with Standard eyes can receive additional support by extending the second leaf or a wrap plate.

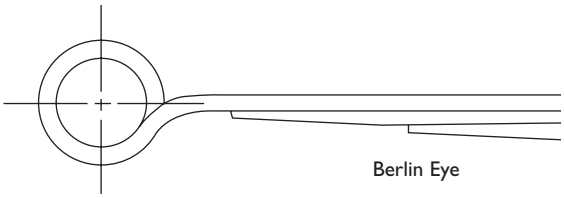
Berlin eyes places the load through the centerline of the Main Plate, which reduces lateral deflection.

Reverse eyes will lower a vehicle while providing maximum spring travel.

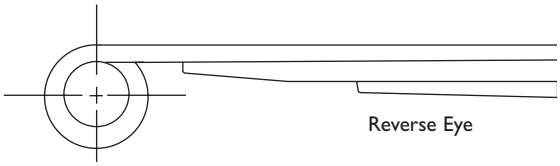
The disadvantage of Berlin and Reverse eyes is that they cannot be provided additional support from the second leaf. However this may not be required in most cases.



Standard Eye



Berlin Eye



Reverse Eye

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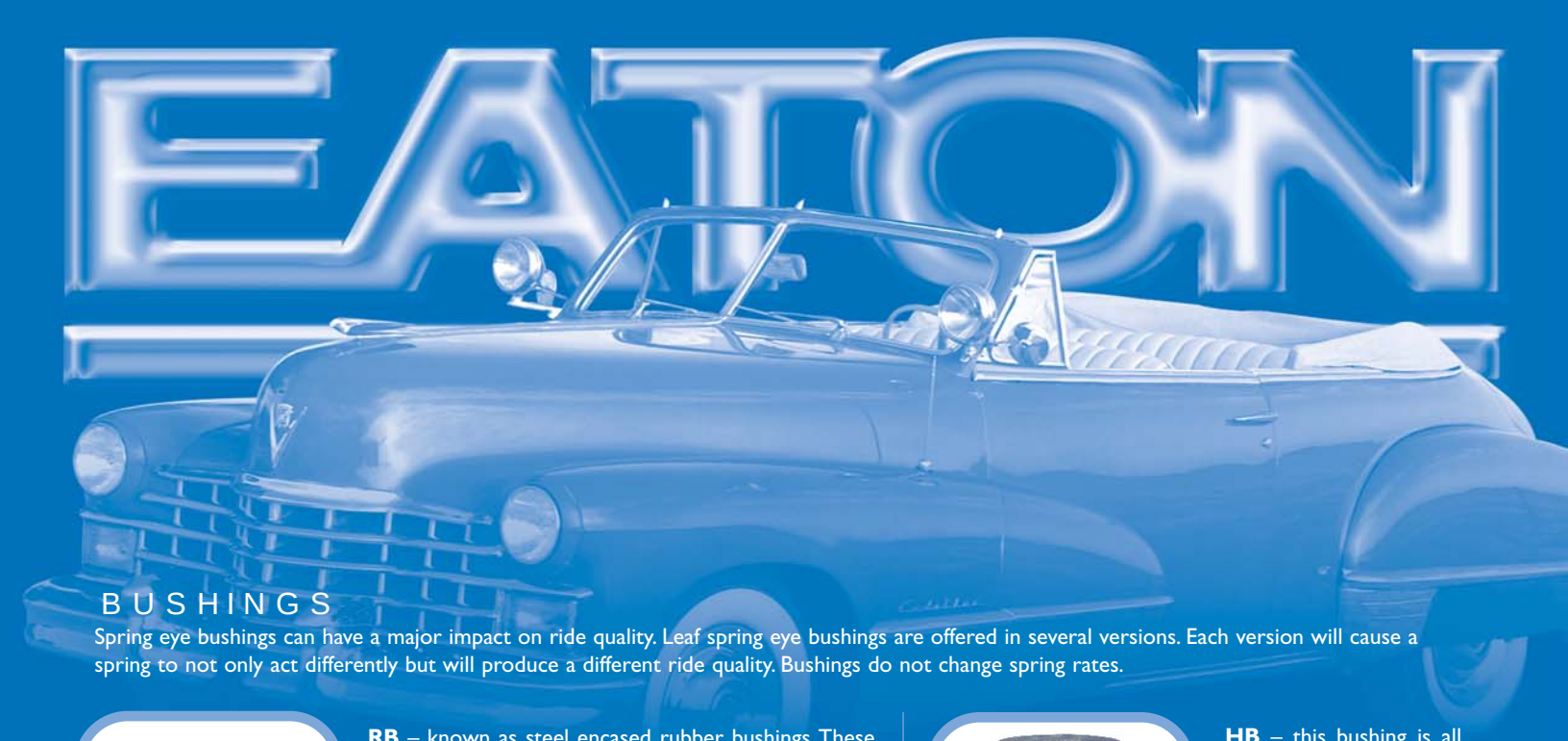
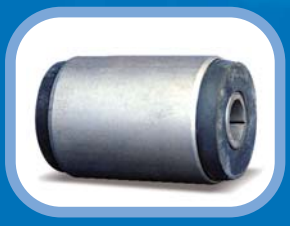


BUSHINGS

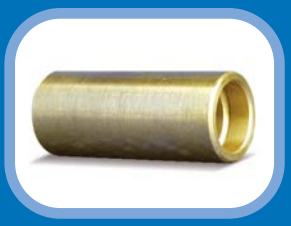
Spring eye bushings can have a major impact on ride quality. Leaf spring eye bushings are offered in several versions. Each version will cause a spring to not only act differently but will produce a different ride quality. Bushings do not change spring rates.



RB – known as steel encased rubber bushings. These bushings are used on the front eye of most automotive springs. They are made of rubber encapsulated between an inner and outer steel shell. The rubber in RB bushings is compressed to one-third of its visible size. RB bushings provide the best all around cushion.

HB – this bushing is all rubber. Many automotive applications use HB bushings in the rear eye. HB bushings perform the same as RB bushings.

Urethane – also called Polygraphite and is very similar in looks to HB bushings. Almost an immediate hook up is the main benefit of Urethane bushings. The transfer of all road imperfections through the vehicle is the main disadvantage of urethane bushings. Urethane bushings are available in an assortment of colors.



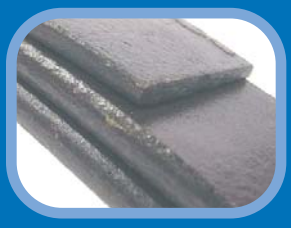
Bronze – used on older light trucks and many medium and heavy-duty trucks. Bronze bushings are greaseable and provide very long life.

Aluminum – or all steel offers absolutely no cushion from road conditions and the vehicle body. Both Urethane and Aluminum bushings should only be used on performance machines where ride is not a factor.

Threaded – also found on older cars, light trucks and most heavy-duty trucks.

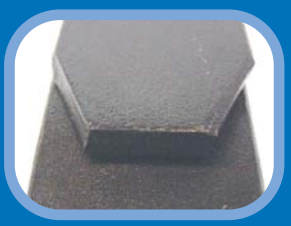
LEAF ENDS

How the ends of the leaves are finished will have a major affect on the ride quality a spring will provide. The ends of the individual spring leaves can be formed in three basic fashions. Springs that are identical except for the end finish will perform differently.



Square or constant thickness ends are often unsatisfactory for automotive springs. Concentrations of interleaf pressures, friction and stress result in a very poor acting spring for lightweight vehicles.

Rolled ends gradually decrease in thickness. The reduced thickness at the ends allow for increased flexibility of the leaf end, resulting in reduced stress and interleaf friction. Rolled ends produce the smoothest acting spring.



Diamond Point ends are the same as square cut except excess material on the ends is cut off. Diamond pointing will result in a better-stressed spring. This end is fine for working truck applications.

Delrin Tip Inserts installed in the end of the longer leafs help improve spring action by helping reduce interleaf friction.

However, a certain amount of **Interleaf Friction** is helpful to a suspension. Interleaf friction helps control excess body roll and oscillations. If all interleaf friction was removed, as it is on vehicles with mono-leafs and coil springs, sway bars should be installed in order to reduce body roll.

MEASURING THE LENGTH OF LEAF SPRINGS

The most popular method used to measure the length of a leaf spring is eye to eye.

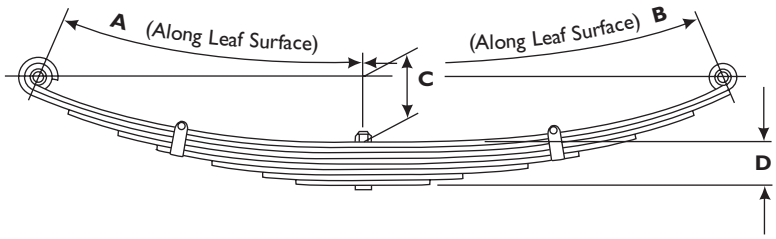
As a spring flexes up and down the eye to eye length changes. A 48-inch spring that has a 6-inch arch will measure 46-3/4 inches eye to eye. With a 3-inch arch the eye-to-eye measurement is 47-3/4 inches.

The correct way to measure a spring is to measure as though the spring was flat. Following the curve of the spring, measure from the center of the front eye back to the center bolt (A), then measure from the center bolt back to the center of the other eye (B), again following the curve of the spring.

This method will provide for the correct length no matter what the arch of the spring is. Additionally because the axle location is determined by the location of the spring center bolt measuring this way provides for accurate axle positioning.

MEASURING FREE ARCH

Free Arch is how much arch is in a leaf spring when there is no load on the spring. To check the Free Arch draw a line through the center of the spring eyes. Then measure from that line to the top of the main plate (the leaf with the eyes) next to the center bolt. (C)
This measurement can be positive or negative.



Measuring free arch by placing the spring upside down on the eyes on a floor and measuring upward is unacceptable. Leaf thickness, different eye sizes, distorted eyes, twisted eyes, uneven floor, etc. can and will lead to an inaccurate measurement.

COIL SPRINGS

Coil Springs do not provide the attaching linkage or structural members like leaf springs. Coil springs simply provide the suspension requirements for the vehicle. Additional parts are used to attach the axle to the vehicle. IFS and IRS use a whole bunch of parts, while straight and split axles use trailing arms from the frame back to the axle.

A Coil spring is made from a round bar of steel that is twisted in an upward spiral shape.

Strength of coil springs are determined by the:

- diameter of the wire
- length of the wire used
- diameter of the finished coil
- number of coils

Coil springs can be manufactured with either a fixed constant rate or with a variable rate. However, unlike leaf springs, the rate cannot be changed.

Coil springs are the easiest and least inexpensive spring to manufacture, however their initial set-up is time consuming and costly. Because they cannot be adjusted to compensate for varying loads they are generally used where it can be assumed that the weight will be constant, like autos and the front of light duty trucks.

Coil springs have three types of ends:

- Tangential – where the end of the coil continues to twist into space. The top coil of the left spring above is tangential.

- Square – which will allow the coil to stand straight when placed on its end. The bottom coil of the left spring above is square.

- Pigtail – where the spring ends curl inward. Both ends of the right spring above are pigtail.

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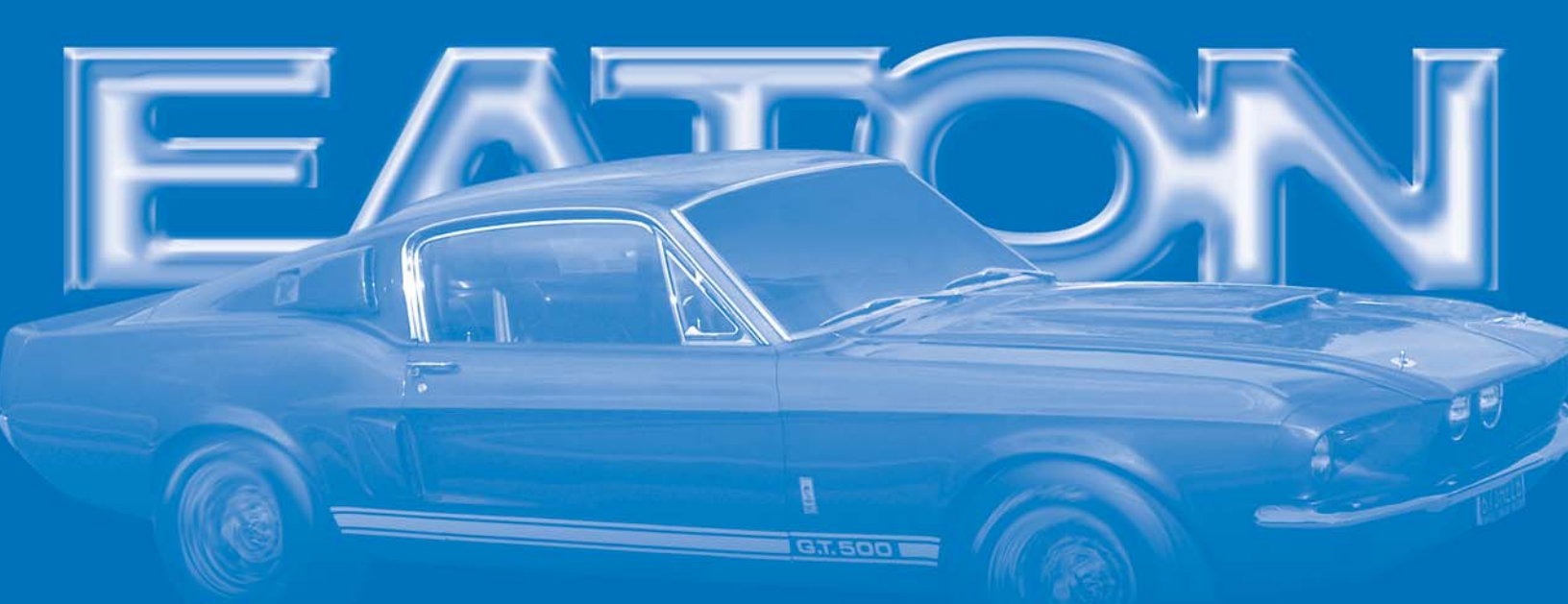


SPRING TERMS

RATE simply put, rate is the amount of weight required to deflect the spring 1-inch.
The lower the rate, the softer the spring.

Rate can be figured mathematically by using a formula that calculates the strength of the size steel used, the length of the spring and the number of leaves for leaf springs, or the number of coils for coil springs.

LOAD is the amount of weight the spring is designed to carry at a certain height.
This is also called Design Load or Load Rate.

Let's say a spring has a rate of 200 lbs. per inch and designed for a 3-inch deflection, when deflected 3 inches the spring is supporting 600 lbs. Therefore, the spring has a Design Load or Load Rate of 600 lbs., not a Rate of 600 lbs.

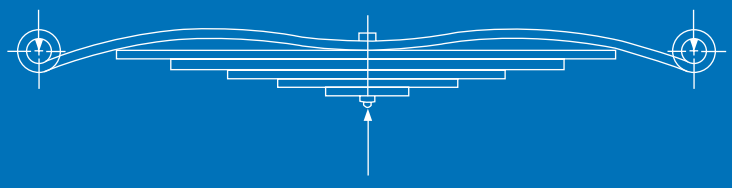
FREE ARCH is how much arch is in a leaf spring when there is no load on the spring.
(C) on the diagram on page 4.

LOADED HEIGHT is measured the same as Free Arch except the spring is under load.
(C) on the diagram on page 4.

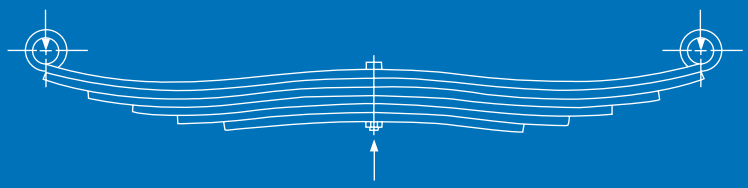
DIVISION LENGTH is what the (A) and (B) dimensions on the diagram on page 4 are called.
Typically the front (A) is the Short End (SE) and the rear (B) is called the Long End (LE).

STEPPING is the distance from the end of one leaf to the end of the adjoining leaf. Stepping is very important. Stepping controls the shape and strength of a spring when under load. Too short of distance between the ends of the leaves will cause the upper leaves to bend downward at the ends and upwards toward the center, too long will give the spring a wavy look. Both conditions produce an ineffective spring.

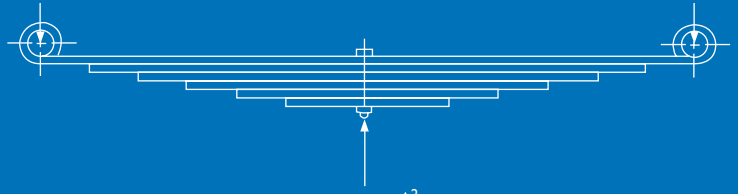
Stepping is critical, a correctly stepped spring can support nearly double the amount of weight than an incorrectly stepped spring.



A - Backing Leaves too short



B - Backing Leaves too long



C - Leaves with S ↑^{2} stepping
(Uniform Strength Spring)

THE MAKING OF A GOOD LEAF SPRING SUSPENSION

Achieving a smooth, nice riding and handling leaf spring suspended vehicle is very simple, provided some basic rules are followed. Just four areas make the difference between a good leaf spring suspension and a bad one.

1) **Multi-leaf springs.** Only with multi-leaf springs can the correct spring design be achieved.

Springs support weight, absorb road shock and set vehicle height. With multi-leaf springs, critical design factors such as stepping, rate, load and spring height can be fine-tuned.

Mono-leaf springs seems to be the fad among street rodders, however, due to production methods; mono-leafs must be made in high volumes. Therefore, they are made with only one rate. Because no two cars are built the same, vehicle weights vary and consistent ride qualities cannot be achieved.

Equally important is ride height. Again, due to production methods, monos are built with the same free height. The only way to adjust ride height is by the use of blocks. Safety is another factor, should a multi-leaf spring break a leaf, including the main plate, there are other leaves to support the vehicle. Monos do not offer this protection.

2) **End type.** Square ends, or constant thickness ends are great for trucks. Diamond pointed or trimmed ends are great for better riding trucks.

However, for the smoothest riding spring, the ends must be tapered.

Tapered leaf ends moves the friction area away from the leaf ends and spreads it over a much larger area, resulting in less force needed to flex the spring.

3) **Blocks.** The use of block to either lower or raise a vehicle is the leading cause of axle windup and poor vehicle handling.

The most secure suspension is one where an imaginary line drawn between the spring eyes is as close to the axle seat as possible. The use of blocks takes this line away from the axle seat resulting in a fulcrum point. This leverage point allows the axle to pivot around the spring seat causing axle windup and handling problems.

Wrong Angle

4) **Shackle angle.** As a spring flexes, it grows in length. The purpose of a shackle is to allow for this growth. Although spring rates are fixed by its makeup, the amount of force required to move a spring can be greatly increased by incorrect shackle angle. Any shackle angle exceeding 15 degrees is too great.

Installing a Pan Hard Bar on straight axle street rods with a transverse spring will allow the spring to be lengthened so the shackle angle can be at 15 degrees or less. The resulting improvement ride can be dramatic.

Correct Angle

FOR ALL SUSPENSIONS

No matter what type suspension your street rod has, leaf spring, traditional coil spring, torsion bar, air, or coil-over, the importance of a high quality shock cannot be understated.

Shocks are the final touch that completes the ride quality of all vehicles. The difference between an "OK" ride and a smooth, comfortable ride can be contributed to the shocks. The only function of any shock is to control the springs' energy.

Non-adjustable shocks lock you into accepting the ride quality that the shock is limited to. Choose by application, not by length.

Adjustable shocks allow you to fine-tune the amount of control you desire, optimizing ride quality.

With the technology in springs and shocks available today there is no reason to have your street rod ride like it is stuck in the 50's. All street rods have the ability to ride and handle like a current production vehicle.

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