

Coil Spring Technical Information

Coil springs are the most common used spring in most all motor-sports today. The reason is because it is very easy to change the component as well as check the rate, unlike leaf springs and some total hydraulic shock suspensions. Furthermore, with the incorporation of the coil-over spring/shock type suspension, the coil spring and shock ratio is close together and operates as one unit. Of the many components that can be changed on a race car chassis, the coil spring change brings about one of the most adverse effects on a chassis.



When choosing a brand of coil springs several issues should be addressed.

- The quality of the material being used.
- The design of the spring.
- The type of end the spring has.
- The true rate of the spring, not just a tag denoting “theoretical” rate.
- Correct markings
- Does it have actual print outs of each spring (data sheets)?
- Standardized testing procedures.
- Are their hidden cost in the spring purchased?



MATERIAL The use of a high quality material such as chrome silicon steel is used to assure a long lasting spring that will maintain a consistent rate and hold free height over many cycles. In addition, the choice of this material will allow a manufacture to wind the spring out of smaller wire to incorporate a larger pitch, which will inadvertently allow more travel and produce a lighter weight spring. In some instances the manufacture may have to choose chrome vanadium wire, instead of chrome silicon. Some springs may need .780 or .810 wire so as to not to be high stressed. Chrome silicon generally comes only in no larger than a .625 size from wire suppliers in the USA. If a manufacturer decides to produce a spring utilizing chrome silicon (.625) wire in lieu of a .710 where the stress levels are too high, then the spring will more than likely loose free height, take set and even in some

cases break. So in some cases, using chrome vanadium for higher rated springs is a better choose than chrome silicon.

DESIGN: Most coil spring failure is directly related to the design of the spring. It is important to design the spring to its environment as well as its intended use. Pitch is the distance between the wires on any given coil-spring. Coil springs wound with an inconsistent pitch will produce an inconsistent rate. If the pitch is consistent, but too far apart then the spring will tend to take set and distort. If the pitch is too close together then the spring may not have as much travel resulting in coil binding. Slenderness ratio needs to be considered when addressing the design

of the spring. If and when the length exceeds the outside diameter ratio then the spring will tend to bow, similar to the shape of a banana. Designing a spring also requires considering the wire size, O.D., I.D., free height, compressed height and static loads that are to be expected on each spring.

SPRING ENDS: The ends of a spring are one of the most crucial of a coil spring. Flat end springs are achieved in two different ways, ground or forged. The ground end springs are the best way to achieve complete spring square-ness. When this is accomplished correctly, spring rates and reactions can be more accurately predicted which in turns makes the chassis more predictable. Furthermore, there will tend to be less stress on the spring and spring related because the pressure will be equally distributed throughout the spring and chassis. The less desired method is the forged or stamped method.



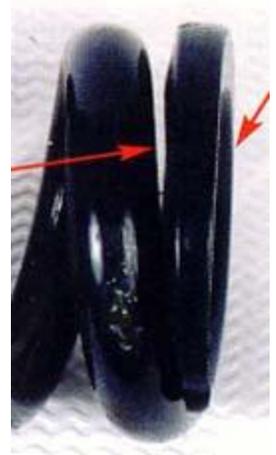
Landrum Spring feels that forging has more negative than positive effects and should not be used in racing applications where accurately rated springs are crucial. Forged ends are only desirable when mass production of a loose tolerance spring is acceptable, for example, the agriculture or industrial industry.



To accomplish a forged flat end, the spring material has to be heated more than once. The first heating of the material comes when the end of the wire is stamped and the second heating process is when the wire is being rolled to a coil form. Every time that the material is heated, it removes carbon from the material. The more carbon removed from the material, the more "hardness" is removed from the wire. As a result, the spring will tend to fail under loads. Simply grinding the spring flat after forging it is like putting excessive ketchup on a bad hamburger. It doesn't solve the problem of multiple heat runs it simply tries to hide the fact. Another negative effect of forged end springs is the fact that the chassis settings may change. For example, if the spring is beveled on the flat end instead of ground flat then the spring is not coming in true contact with the jack bolt plate. To check if the spring and jack plate is making true contact, simply inspect the contact points. Not having true continuity between spring and jack plate is an undesirable trait. The spring will not have any consistent spring pre-load from one spring to another; as a result, the chassis will not respond consistently. Inspect the end of the spring wire, if it appears to be splayed or tapered you can rest assure the ends have been forged.

The other types of ends are the closed and open tangential ends. These types are desirable where stock lower control arms are used. There are pro and cons to both types.

The completely closed-ends are used when the requirement is that rate remains more consistent throughout the coil springs' travel. The disadvantage is that the spring will not tend to lock in place and may turn in the control-arm bucket. Several top-level teams have found that this movement actually causes the car to handle inconsistently. When the car is jacked up during a pit stop for a tire change, the suspension may become completely unloaded leaving the coil spring to rotate in the spring bucket. The engine vibration and the contact of the new wheel being installed on the hub face generally causes enough instability to cause the spring to shift in the pocket. When this occurs, the car will increase spring pre-load and do one of two things. When it happens on the left front, the chassis will lose bite. When it happens on the right front, the chassis will gain bite. As a result, the car will have unpredictable chassis characteristics and may cause premature tire wear. Moreover, on super-speedways, the raised frame height will result in the car having to push too much air. When using the closed-end type springs, we recommend that the spring be wire tied in place just enough so as to hold the spring in place, but not where the spring is in a bind.



The open-end type springs are required when spring security of location is desired. For example, ARCA and other type stock car chassis whose accuracy of pit stop changes are a necessity. These springs tend to stay locked in place when the suspension is unloaded; for instance, changing a tire during a pit stop. The disadvantage of this style spring is that the spring rate has a progression in spring rate. Meaning that as the spring is compressing it is gaining rate. For instance, a 1300 lb. / in spring may be 1325 the first inch, 1395 the second and 1460 the third inch. One negative scenario is the fact that the right front compresses at a faster and compresses more than the left front, the chassis may tend to gain cross. Causing the right front tire to have a higher tire temp, as a result, a shorter life of the tire.

TRUE RATE OF A SPRING: Knowing the actual rate of each spring is crucial. Whenever a manufacture sets up to run several hundred springs of one particular rate, the end result is less than perfect. Even though the winding process using CNC automated equipment is consistent, the variances in the quality of spring wire is not as consistent. As a result, not every spring will come out exact. No one including us can guarantee every spring to rate out exactly. Knowing this, **Landrum Spring** as elected to rate, dyno, print (numerical as well as graphical data), engrave each spring's serial# and rate. Furthermore, **Landrum Spring** is recognized as the only company in the racing industry worldwide doing so.

The reasons are easy. For example, if the spring industry standard is say 5%. Then a 2,000# spring could be anywhere between 1,900 to 2,100# Here is a typical situation found at any given track. Let say that a chassis engineered wanted to increase the right front spring rate by only 200# The current spring is tagged 2,000#; however, the unknown actual rate is 1,900# The new spring is tagged 2,200#; on the other hand, the unknown rate is 2,310 # The actual total spring change instead of 200# is 410#, over 100% more or twice the spring change desired.

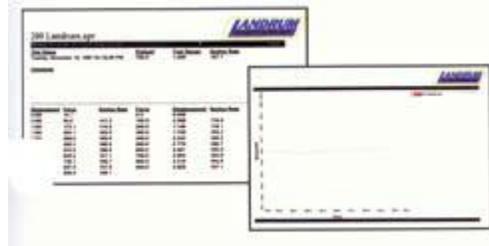
Some manufactures even feel and state that racers should monitor a spring's free height instead of its rate. **Landrum Spring** as well as many top-level teams have found this to be counterproductive when setting up a car and compiling consistent results. While it is important to monitor free height for spring set, it is more crucial to know the actual rate in its working range. For example, while testing at Charlotte, a car had a 375# tagged spring in the rear, the

driver felt that the car was loose on corner entry and the Hoosier tire temperatures supported his feel. After stiffing the spring to a 400# tagged spring the driver did not feel any changes. The tire temperatures still supported his feel. After the supposed spring change, the team then began to change shocks, sway-bars, and pan-hard bar heights. At the end of the day, the springs where rated. After viewing the data sheets we found that the 375# tagged spring was actually a 387# and the 400# tagged spring was a 385#. So the actual change in spring rate was not an increase of 25# as was intended but a decrease of 2#. This is why the driver and the tire temps showed no change. Furthermore, the crew made unnecessary changes, wasted valuable time, resulting in wear and tear on the engine, tires and other components.

CORRECT MARKING: Having a spring with the correct markings is very crucial. Most companies incorporate a metal tag denoting the “theoretical rate” of each spring. These theoretical rates are just that, “Theoretical”. Knowing that every spring has its own characteristics, Landrum Spring, engraves the exact rate of each and every **GOLD COIL** to 1/10# For instance, a J200 (5”o.d. x 13”tall x 200# coil spring) may be engraved 201.8.



SERIAL NUMBER: Having a spring that has its own serial number is important. Every **GOLD COIL** has its own dyno sheets incorporated in its box when leaving our facility. If a user was to lose their sheets then we should be able to pull the data up at a later date. Furthermore, if in the event that there is a spring failure, we can trace the spring’s history and make up all the way back to the wire source. This is important due to the fact that some springs may be in various warehouses, dealers and chassis shops for up to two – three years before reaching the race team.



DATA PRINTOUTS: Having springs packaged with data information is crucial to any serious race team. All of the **GOLD COILS** are packaged with dyno sheets detailing the dynamic rate in a graphical form as well as numerical form. These data sheets clearly shows the details of the load in pounds of force, in increments of 1/10th of an inch for each and every **GOLD COIL**.

STANDARDIZED TESTING: Landrum Spring uses the same rating system that many of the race teams that participate in the premier race divisions (CUP, ARCA, and IRL uses.) Through interviewing various teams, we found that current spring suppliers were using many various methods of rating coil springs. These methods, good or bad, can be confusing at times. We felt that more standardized rating would be helpful to everyone involved. Each and every data sheet clearly shows the pre load as well as the displacement that the spring was tested at. This eliminates the inaccuracies and confusion of trying to figure out how each spring is rated.





SPRINGS WITH HIDDEN COST \$\$\$\$: Simply put it, buying **GOLD COILS** may save most any race team money. By purchasing springs that are already accurately rated, you will not have to pay your engineer (\$\$\$\$), team manager (\$\$\$\$), or crew chief (\$\$\$\$) to rate springs that you have purchased. Furthermore, a race team will not have to purchase additional springs to fill the void left by the springs that did not rate properly to the “theoretical rate” that they were supposed to be. In addition, teams would not have to purchase expensive testing equipment. Moreover, accurate spring changes will allow teams to be more progressive in their test sessions and eventually reflect in their qualifying efforts and then onto the race.

DISPOSE OF DAMAGED SPRINGS: While springs are made of a high-tensile strength wire, they are susceptible to damage from impact. Springs should be replaced after a chassis has received a severe blow. If there are any marks or distortions on the spring they should be discarded. Many times hair-line fractures and cracks cannot be seen without the aid of a fluorescent penetrant inspection. Reusing a damaged spring could have negative consequences.



HOPEFULLY THE INFORMATION CONTAINED IN THE TECHNICAL AREA HAS BEEN HELPFUL.