Glossary of Wire Terms

To better serve our clients and prospective customers, we have included a Glossary of Common Terms. We hope that you find the information beneficial. if you have any suggestions or comments, we would appreciate you sending us an email with your comment. Though not exhaustive, this listing includes many useful definitions of wire terminology that springmakers may encounter. By *David Merrills, Industrial Steel and Wire*

Air Patenting– The cooling of the rod or wire is accomplished in air as apposed to lead. (See Lead Patenting.)

Alloy– A mixture or combination of metals forming an apparently homogeneous mass.

Annealed– For the purposes of this glossary, I will restrict the comments to stainless steel wire. Annealed stainless has been heat treated at high temperatures (about 1950°F) and then cooled quickly in order to soften the wire. The typical tensile of annealed stainless steel wire is about 90,000 PSI (pounds per square inch). There would not be any surface coating on the wire, and it certainly would not be used for making springs.

Block– A steel drum-shaped part of a wiredrawing machine. The finishing "block size" will determine the inside diameter (ID) and outside diameter (OD) of a coil.

Bright Drawn– Broadly accepted to mean a wire with no metallic surface coating such as zinc (galvanized).

Bull Block– Typically a large-diameter drawing block for producing large-diameter wires.

Cable– A term loosely applied to wire ropes and wire strands.

Cadmium– Cadmium-coated wire is sold in much the same way as tinned wire. Cadmium is a bluish-white metal. It is important to note that cadmium is considered a hazardous material and is not RoHS compliant.

Carrier- Sometimes called, a "rack," "stem," "spider" or "former." This is a tubular metal form that stands vertically. The wire is either gravity-fed onto it or individual coils are stacked onto it. It is an effective way of producing large continuous coils or stacking mill coils for storage and transportation.

Cast– The cast is the shape or configuration of one or two turns, or convolutions, of wire taken from a coil. "Bad cast" probably means that the wire is wild or has a bad helix (spiral), or the diameter of the cast is too small or, in some cases, too large. However, bad cast does not necessarily mean bad helix and visa versa. The terms are often confused (see Helix).

Coils- Referred to as "mill coils" or in England as "catch weight coils." This is an inexact weight of wire as opposed to exact weight coils. Typically, coils and carriers are mill coils, i.e. not exact.

Cold Drawing– Pulling wire at normal (room) temperature through a die in order to reduce the cross-sectional area; that is to say, make the wire smaller in diameter. Shaped wire is usually produced by cold rolling. This process increases the tensile and yield strength of the wire while decreasing the ductility. (See Shaped Wire.)

Cold Heading (Wire)- This is a specialized type of wire that is used mainly for screws, rivets and nuts, broadly described as "fasteners." Cold heading quality wire has a premium surface and is generally supplied in the annealed or slightly cold-drawn condition.

Cotter Pin Wire– Usually half-round wire.

Diameter Tolerance– Most all wires have a permitted diameter tolerance variation on the nominal wire size. This is usually expressed as a plus or minus variance that is given in the standard wire specifications. The wire is also permitted to have an ovality tolerance, as it is extremely difficult to produce a perfectly round wire throughout a batch of wire. Some springmakers may request a “tighter” tolerance than the specification allows, so this has to be discussed and agreed upon with the steel supplier.

Die– Wiredrawing die. A specially shaped hole through which the wire is pulled in order to reduce the diameter. Dies may be made from tungsten carbide, ceramics, diamonds or synthetic industrial diamonds.

Electro-Polishing– A process based on chemical/electrical surface treatment that produces a shiny surface. This process removes metal from the surface and consequently reduces the wire diameter very slightly.

Elongation– The extension of a tensile test piece when stressed. The elongation at fracture is usually expressed as a percentage of the original gauge length. In broad terms, it is how far the wire will stretch before breaking. The amount of plastic or permanent elongation is measured from a tensile test specimen before fracture. Typically, as hardness or strength increases, elongation decreases.

Galvanized Wire– Wire to which a coating of zinc has been applied to the surface as a protection against corrosion. Galvanized wire is often produced by hot dipping the wire into molten zinc. This is called “hot-dipped galvanized.” Electro-galvanized is a method of applying zinc electrolytically.

Grease Drawn– Usually gives a fairly bright shiny finish. The electropolishing quality type is typical of this. Grease drawn is usually only applicable to stainless steel wire.

Hard Drawn- Most of the time when springmakers specify “hard drawn,” they mean bright hard-drawn, usually to ASTM A-227. Galvanized hard-drawn is usually to ASTM A-764.

Heat Number– A number given to a ladle (cast or heat) of molten steel as part of the steel mill’s traceability. If a springmaker has a wire problem, he may often ask for a different heat number. There is a good chance that a different heat number was made at a different time and the wire characteristics may differ.

Helix- Often checked by laying a couple of convolutions on the ground and measured by the “lift.” Helix is a measurement of how high the end of the wire lifts off the ground or flat surface. Another way to measure this is to suspend a couple of coil convolutions from your finger. If the wire spirals or corkscrews from side to side, this is sometimes called “separation.”

Inconel, Incoloy– These are nickel-chrome alloys with very good resistance to corrosion and for working in high temperatures, or both. These alloys have a very low magnetic permeability of about 1.0 (almost non-magnetic).

Lead patenting– Patenting of rod or wire is a process whereby the material is heated in a patenting furnace and then quenched (cooled) almost immediately in a bath of molten lead. The temperature of the furnace is about 1600-2000°F. The lead temperature is in the range of 840-1000°F.

Music Wire– This is a fairly high-grade, high-carbon steel wireto specification ASTM A-228. It is a “cleaner” steel than hard drawn and exhibits a better fatigue life. Today, music wire is made by either direct drawing from rod or lead patenting. As a guide, most stocked music wire thicker than 0.0625" is more likely to have been direct drawn; whereas wire smaller than 0.0625" will have been made from lead-patented rod or wire. Wire made by the patenting method has a higher cost.

Nickel Coated– Stainless steel tends to be sticky during cold drawing, and coating these grades with nickel can enhance the surface quality. Typically some stainless wire has a surface coating or lubricant, which is nickel (metallic). Nickel is a soft, metallic material that is an excellent lubricant for spring coiling. Special music wires may also be supplied with a nickel coating. Suzuki has the trade name of “Preco-N” for this product.

Nickel Plating– This is usually carried out after the spring or wireform has been made. The nickel plating is usually for cosmetic purposes, as it is typically bright and shiny. Do not confuse nickel plating with nickel-coated wire.

Passivation– According to ASTM A-380, passivation is “the removal of exogenous iron or iron compounds from the surface of stainless steel by means of a chemical dissolution, most typically by a treatment with an acid solution that will remove the surface contamination, but will not significantly affect the stainless steel itself.” In addition, it also describes passivation as “the chemical treatment of stainless steel with a mild oxidant, such as nitric acid solution, for the purpose of enhancing the spontanous formation of the protective passive film.”

Phosphate– Also called “phos-coated.” Unless we are discussing galvanized music wire, the surface coating on music wire is usually phos-coated. The wire, or rod, is coated with zinc phosphate prior to wiredrawing. Added to the phosphate coating may be lime or a borax coating, plus the die-box drawing soap. This coating achieves several things: It permits the high-speed drawing of the wire because of its lubrication properties, it is a good spring coiling lubricant, and it offers a limited protection against rusting. The appearance of the wire is almost black, with a light oil on the surface.

Reels, Spools, Bobbins– Typically, if the wire is not supplied in coils or on carriers, it can be wound onto a reel. Depending upon wire size, the large diameter wires are supplied on reels and the small sizes on spools. These can be made from steel, wood or plastic. The three critical dimensions of a reel are: flange diameter, arbor or center spindle hole, and traverse width.

Reeless Core– Sometimes called a “core.” Basically, it is a coil that has been drawn onto a collapsible reel. The reel is collapsed and taken away, leaving a reeless core.

Reverse Bend Test– Commonly referred to as a “bend test.” This is a test used to determine the ductility of the wire. The wire is typically bent backwards and forwards through 180° over a specified bend radius until it breaks. The number of times it could be bent before fracture is recorded on the test certificate.

Rockwell Hardness– Rockwell hardness is determined by pressing either a steel ball or diamond indenter into the surface of the test piece then measuring the depth of the impression. It is not usual to test wire this way. Wire “hardness” is usually expressed by its tensile strength, with the result expressed as PSI (pounds per square inch). Hardness tests relate more to flat products, i.e. strip and sometimes shaped wire.

Rod– Also called “wire rod” or “hot-rolled rod.” Wire rod is the raw material from which wire is drawn. Rod is produced from a heated billet of steel. This is passed through a series of rolls by which it is reduced in cross-sectional area. This process is called

"hot rolling."

Rust– Corrosion results from the action of moisture and air at normal temperatures on iron and steel products. This is sometimes called "oxidation." This can happen to bright carbon steel wires, such as hard-drawn, music or basic, and sometimes oil-tempered. "White rust" is specific to galvanized wires and is a film of zinc oxide caused by moisture.

Seam– A seam or longitudinal crack in the wire that is usually the result of a seam being present on the rolled rod. This typically happens during the steelmaking process Seams can be superficial and not impair the fatigue performance of the material, or they can be more severe and initiate fatigue cracks.

Shaped Wire– This is the term generally used to describe wire with a cross-sectional shape other than round. Shaped wire is usually produced by cold rolling.

There are potentially an infinite number of shapes possible, but generally they fall into the following broad categories: square, flat, oval, half round, rectangular or wedge shaped.

Shell- This is a rare problem these days, but it refers to the presence of residual scale on the wire surface as a result of insufficient descaling of the wire rod prior to the drawing stage.

Soap-Coated Wire- Stainless wire can be soap-coated non-metallic, or nickel-coated metallic. "Soap coated" broadly defines the surface coating or lubricant on the wire. The coating is indeed a soap derivative.

Spheroidizing– A heat-treatment process carried out at a uniform temperature followed by a slow cooling in order to obtain a suitable microstructure for cold working (spring coiling). This results in the carbides being agglomerated into a spheroid form, which will eliminate hardness or brittleness of high-carbon wire while maintaining most of its strength. Spheroid annealing results in a very ductile structure often necessary to form parts on a fourslide or in a press. Parts are subsequently heat treated to the desired hardness.

Splitting or Split Coils– Term used to describe coils that have been made smaller (lighter in weight) by separating one part of the coil from the other, cutting it apart and tying up separate "split" coils.

Springs (Wire)– These fall mainly into three broad categories: compression springs, which in service are compressed; extension springs, which are pulled apart or extended; and torsion springs, which are twisted. Torsion springs are designed to operate by relative angular displacement of their ends, sometimes called "legs."

Stainless Steel– A high-chromium steel, often including nickel, which is resistant to corrosive and oxidizing attack. The most well-known type is 18/8, an austenitic steel containing about 8% nickel. The carbon is typically kept low. This is often referred to as "Type 302" or "Type 304." The main difference between the two grades is that Type 302 has a maximum permitted carbon content of 0.12%, whereas Type 304 has a maximum permitted carbon content of 0.08%. As a rule, 304 will almost always meet the 302 analysis but not the other way around. The term "stainless steel" is, to some extent, incorrect; there are no steels that are wholly immune, in all circumstances, to corrosive attack by all the substances with which they can come into contact.

Stress Relieving– Heat treating the formed spring to, and if necessary holding at, a specific temperature. This is usually followed by a slow cool for the sole purpose of relieving the internal stresses created as a result of spring coiling. It is performed

on springs to reduce the high local tensile stresses that occur as a result of coiling or bending. The inner radius of compression springs and the bends in the arms of torsion springs are examples. These areas of high stress concentration can be deleterious to the spring's fatigue performance.

Tensile Test– This is used to measure tensile strength, often expressed as UTS (ultimate tensile strength). In the U.S. almost all tensiles are expressed as PSI (pounds per square inch). The wire is actually tested by pulling or loading the wire in a tensile machine until it breaks (actual breaking load). This load figure is then divided by the original cross-sectional area of the wire in order to calculate tensile strength, which is expressed in PSI.

Tin– This is a soft white metal, very malleable and ductile, but of low tensile strength. Both bright hard-drawn and music wire tin-coated material is supplied with no appreciable change in tensile strength. Both comply to their respective spring wire specifications. After plating, the wire looks like silver.

Tolerance– Diameter tolerance is the amount by which the diameter of the wire is permitted to vary above and below the specified size.

Torsion Test– Sometimes called a "twist test." This is a test whereby the ends of a measured test length are secured and the wire is twisted in a torsion testing machine, usually until it breaks. The number of twists is recorded as part of the mechanical testing procedure. This test can also reveal seams in the surface of the wire.

Valve Spring Wire– Often oil-tempered chrome silicon wire per ASTM A877. Usually this wire is subject to very special processing and inspection, in terms of surface, to prevent complete decarburization and severe surface defects. "Regular" chrome silicon (ASTM A401) is not valve quality.

Wet Drawn Wire – Wet drawing is a process in which the wire is drawn while submerged in an oil- or grease-type lubricant. This usually results in a bright shiny finish. This bright finish is not particularly good for spring coiling, as there is no real lubricant on the wire surface to facilitate automatic spring coiling.

Wire Gauge – Wire gauge sizes vary in interpretation, not only from country to country but also by wire type. It is better to refer to wire size by actual wire diameter.

Wrap Test – This is a test of the wire's ductility. Typically, the wire is wound onto a mandrel of the same size as the wire diameter to be tested. An acceptable result would be that the wire is wound seven or eight turns in such a way without splitting or breaking. This test can also be used to test the adhesion of plating on the surface of the wire such as zinc (galvanized).

Yield or Yield Point– This can be part of a tensile test. The yield point is where there is a sudden increase in elongation (stretch) without any corresponding increase in load as the wire is being pulled (see Tensile). The point at which this occurs is called the "yield point." The yield point is always lower than the UTS (ultimate tensile strength). The yield point is also the point at which the material begins to plastically deform or yield. Beyond the yield point, a material will not return to its original shape; that is a spring that takes "set" has been loaded beyond the yield point of the material.

Zinc– Zinc plated or galvanized wire. Zinc is a bluish white metal that melts at a relatively low temperature – about 780°F. The zinc is used to plate wire (galvanizing) in order to protect against rusting. Larger sizes are typically made by dipping the wire in molten zinc (final hot dip). Smaller sizes are galvanized and then drawn to the finished size (drawn after galvanizing – DAG.) Zinc can also be applied by electro-galvanizing; that is to say the zinc is applied electrolytically.

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David Merrills is vice president of Industrial Steel & Wire in Bristol, CT. Readers may contact him by e-mail at dmerrills@industeel.com or phone at (860) 589-7755.