

## **What's That Cage Made Of?**

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*Abstract.* The materials and techniques used in bird cage manufacturing vary tremendously. Most cages are constructed primarily of steel with some form of anticorrosive coating. Cages designed to house larger psittacines are typically powder coated or made of stainless steel. Cages designed for smaller birds may employ less expensive techniques such as plating, galvanizing or plastic coating the steel wire. Enclosures designed for outside use are commonly made of galvanized steel. Powder coated steel, stainless steel mesh, Zoomesh, and Phantom Mesh offer safer, more attractive, longer lasting alternatives for outdoor aviaries.

### **Introduction**

There are currently no standards regarding construction of bird cages for pet birds. Whether the cage is intended for small or large companion birds, the materials used for construction are as different as the designs themselves. The variability of materials is more extreme in smaller bird cages where cost is more often a primary consideration, and fewer demands are placed on the structural integrity of the cage. Large psittacines require greater tensile strength in cage components due to the extreme force these birds can exert with their beaks. The need for greater tensile strength usually translates into more costly materials and a more predictable product.

### **Components and Manufacturing Techniques for Indoor Birdcages**

One of the most common materials used to make bird cages is steel. Steel is composed of iron and carbon and, if left untreated, oxidizes very easily. Grades of steel differ primarily in purity, varying in carbon or other alloy content. Higher grades of steel are typically subjected to heating processes that result in a tempered product with a smoother finish. Wrought iron and cold rolled steel are similar types of carbon steel, with wrought iron having a less finished surface and rougher texture, and cold rolled steel having a more finished, smoother surface. Hot rolled steel is subjected to additional heating processes that result in an even smoother finish. Regardless of how the carbon steel is produced, it must be finished with an anticorrosive material to prevent oxidation.

The best way to prevent corrosion and add tensile strength to steel is to add the elements chromium and nickel, producing stainless steel (S/S). Stainless steel cages have become extremely popular in the last few years as consumers demanded safer, longer lasting, and more beautiful enclosures. Stainless steel cages are designed to last for 50 years. If designed well, they provide a safe, secure, beautiful, and easy to maintain enclosure. The high cost of these enclosures reflects the increased costs of raw materials and more labor intensive construction techniques. Stainless steel cages are most commonly used to house larger psittacine species. They are particularly well suited for large macaws and cockatoos which are capable of dismantling inferior materials. Stainless steel cages have also become popular for many medium sized birds. Even though these birds usually do not test the structural integrity of the enclosure, stainless steel cages provides a safe, lasting, easy to maintain environment for pet birds.

Powder coating is a technique commonly used to prevent corrosion of steel. It provides a durable finish that helps protect steel components. Powder coating involves the electrostatic application of a specialized paint, followed by high temperature baking. The finished product is versatile and

attractive. Although originally designed for lawn furniture, this technique caught on in bird cage production. Some of the original powder coating formulas contained high levels of zinc to harden the finish and speed curing time. Most formulas currently in use have eliminated the need for zinc. Variability in paint formulas and application processes will affect the finished product and can result in chipping, peeling, and corrosion. Most cages commercially available today for medium and large psittacines species are powder coated steel. These cages, if properly manufactured, will provide decades of service and functional, safe, beautiful enclosures. Recent market trends show a rising demand for powder coated cages for smaller birds like budgerigars, cockatiels, and lovebirds. Two manufacturers, Animal Environments and California Cages, have responded to this demand with cage models for smaller birds. The Animal Environments cage designed for budgerigars, the Barcelona, utilizes materials and manufacturing techniques previously only seen in large bird cages.

While powder coated steel is the safest type of painted cage, some manufacturers sell powder coated galvanized wire cages as an inexpensive alternative. These cages pose an increased risk of zinc consumption. In many cases this is due to the fact that proper preparation for powder coating involves some roughening of the surface to be painted. This roughening can pit the galvanized surface and result in irregularities. Powder coating often adheres poorly to slick galvanized surfaces and can quickly peel and flake. The paint flakes can contain high levels of zinc, which has leached from the galvanizing into the powder coating. Pet birds intent on cage chewing can quickly ingest toxic levels of zinc and/or lead which is a common industrial contaminant of some galvanized wire (see below). Unfortunately, most owners who purchase these cages are unaware that they are buying an inferior product.

While stainless or powder coated steel cages are ideal, less expensive methods of preventing corrosion are commonly used in bird cages designed for smaller psittacines, whose owners tend to be more cost conscious. The most commonly used method involves electro-plating steel wire with an inexpensive metal to prevent oxidation and corrosion. Zinc is probably the most commonly used metal for electroplating. Some manufacturers will layer different metals over the steel to achieve the desired result. The resulting wire is usually a shiny silver color but can also be shiny gold. Most electroplated finishes contain at least some zinc. An informal survey of commercially available cages (8 randomly chosen) for smaller parrots revealed zinc levels in the plating from .5% to 42%.

Electrostatically applied plating is unlikely to be consumed by a bird as long as the finish is smooth. However, once the cage shows signs of oxidation, pitting, loss of sheen, or white rust, the cage poses unacceptable risk of zinc ingestion, and should be replaced. Cage grates are likely to show degenerative changes first because of the constant exposure to droppings and food waste. Oxidation of these surfaces often result in deposits of elemental zinc. These deposits appear as white burrs or pits. These imperfections can draw the attention of birds. When removed and ingested by birds, these deposits can result in potentially dangerous zinc exposures. Birds that develop behaviors involving chewing, mouthing, or biting the cage are at increased risk and would be safer in a zinc free enclosure.

Another inexpensive method of preventing oxidation involves coating steel or galvanized wire with plastic or vinyl. While these coatings do protect wire from oxidation, they can be easily removed by busy birds. Plastic and vinyl coatings often degrade quickly and flake off the underlying wire. As lead is a common ingredient of plastic and vinyl, pieces of coating ingested by birds can expose the bird to toxic metals. In addition, ingested coating can act as a gastrointestinal irritant, regardless of its metal content. When a vinyl or plastic coating is used over galvanized wire, there is the added risk of zinc ingestion if the wire is chewed on and eaten.

Galvanizing is the process of coating steel wire with zinc by dipping it into molten zinc. This method is the least expensive way of preventing corrosion of steel wire. Galvanized wire can be distinguished from plated wire in that it is a dull gray, rather than a shiny silver. There are two

primary types of galvanized wire commercially available. Wire galvanized prior to welding is commonly produced in the United States. Wire galvanized after welding is a process more typical of production in United Kingdom, Europe and Asia. Regardless of when the zinc is applied, the welds in most galvanized wire are electrostatic and contain no additional metals. Lead is a common manufacturing contaminant of some galvanizing processes and will obviously increase the risk of problems if consumed. Using higher grades of wire will minimize the risk of lead exposure.

Galvanized cages are the least expensive bird enclosures available, and are often manufactured in large sizes suitable for flight. They are also light and easy to move. Unfortunately the behavior characteristics of many birds include picking at, chewing, and ingesting anything available. For these birds a galvanized cage can pose a huge risk of zinc intoxication. The number of birds adversely affected by these cages is likely under-reported because thorough diagnostics are often not run. The toxic potential of zinc ingestion has been proven but much remains unknown about the impact of chronic, non lethal exposure.<sup>1,2,3</sup> In fact, the biologic mechanisms of lethal exposures remain poorly defined.

Properly finishing galvanized wire eliminates blebs and imperfections, making the cage less inviting to chew. Excess material at welds creates easily removable pieces of elemental zinc. If ingested, these pieces can contribute to disease. Wire that is galvanized after welding usually has a smoother surface, and therefore becomes the preferred wire for aviculture. New galvanized wire is often coated with a petroleum based protective oil. If not washed off prior to use, and if ingested, this oil can pose additional health risks. Sheffield Manufacturing, producers of Tinsley Wire, requires that rolls of wire be sold with a warning label advising of the risk of zinc ingestion, of the need to prepare the wire for usage by removing any residues of oil, and of the need to use a soft brush to remove any tags of material.<sup>4</sup>

Many aviculturists mistakenly think that treating galvanized wire with a vinegar wash will remove any risk of zinc ingestion. While vinegar will dissolve small, oxidized deposits and hasten their removal with a soft brush, vinegar will not remove the zinc coating from the wire.

Acrylic cages have appeared on the market as an alternative to traditional metal wire cages. They certainly offer the advantage of using safe, relatively inexpensive materials and many bird owners find them appealing. Certainly they have distinct advantages for debris containment. However, this same property gives rise to problems with air quality and ventilation. Some have additional built in air cleaners to address air quality problems. Whereas these cages may be suitable at moderate temperatures, the small airspace could become overheated at warmer temperatures.

### **Aviaries and Cages for Use Outdoors**

Structural components used in aviaries and outdoor enclosures are often different from those found in indoor pet bird cages. Cages used in outdoor situations require more durable corrosion protection, as they are exposed to the effects of sun, wind, salt, and rain. Galvanized wire has been the traditional material for outdoor cages, as it is inexpensive and rust resistant. An increased awareness of the inherent risks of metal toxicity however, has led to the development of alternative caging materials suitable for outdoor use. Powder coating non galvanized steel for the production of outdoor aviaries is a new concept that holds tremendous promise. Powder coated steel aviaries are a much safer enclosure for chewing birds than galvanized ones. The material does not require specialty welding and can be built with readily available materials. Certainly the powder coating must be applied carefully to prevent corrosion of the underlying steel. Aviaries utilizing these materials are more costly than galvanized enclosures, yet are more attractive and much safer.

The use of stainless steel mesh of varying sizes and weights has resulted in very successful aviary design and construction. S/S construction requires special welding equipment and special training, but can result in a beautiful finished product. Several sizes and weights of S/S mesh are

commercially available. The least expensive and most versatile is ½"x ½" 16 gauge S/S mesh. The mesh is reasonably easy to cut and weld. The small size of the mesh allows for the housing of many large birds because the opening is too small for the birds to grasp or chew with their beaks. We have used ½" x 2" and ½" x 3" 16 gauge and 14 gauge very successfully. Construction of S/S cages does demand the talents of S/S specialty fabricators.

Heavy gage (10gauge) ½"x 2" S/S mesh, suitable for housing large macaws and cockatoos can be prohibitively expensive. In special situations however, the wire can be used to construct bird palaces. It is necessary to use this heavy a wire to house most cockatoos and macaws. The largest and most determined species could probably damage this wire.

Zoomesh is a light-weight, flexible, stainless steel mesh that has been used in zoos for many years. Although it is generally considered to not be strong enough for most psittacine enclosures, it is possible that small species could be safely maintained in it. Zoomesh comes in two weights, standard and heavy duty. It resists chewing by rodents and other pests. The mesh can be stretched tight over a rigid frame or draped over cables and poles.

Phantom Mesh is a relatively new aviary screening material that is made of inter-linking round weave coils of wire. Manufactured in a variety of sizes and materials, Phantom Mesh can be draped over cables and poles and doesn't necessarily require a rigid frame. Phantom Mesh has the great advantage of being basically invisible from 30 feet. The lightest gauge Phantom Mesh, made of aluminized steel, appears to be well suited for psittacine aviaries.

## References

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3. Romagnano A, Grinden CB, Degernes L, Mautino M. Treatment of a hyacinth macaw with zinc toxicity. J Avian Med Surg 1995;9(3):185-189
4. Information Bulliten:Tinsley Wire (Sheffield) Ltd., PO Box Shepcole in Sheffield S9 ITY, South Yorkshire, UK.

## Manufacturers and Suppliers

Animal Environments  
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Ferdinand or Lora