



美国建筑扣件市场概览

# A Primer on the US Construction Fastener Market

*Construction fasteners constitute one of the four primary families of fasteners in the United States. The global fastener market was estimated in 2021 at a little over 90 billion U.S. dollars. The North American market constituted about 19 billion U.S. dollars of that pie, of which the Building and Construction segment was about 1.5 to 2.0 billion U.S. dollars.*

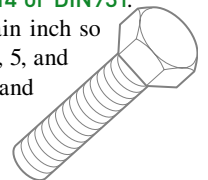
*Although small in comparison to the Automotive and Aerospace fastener segments, these numbers still represent a significant market with potential for both existing and new entrants.*

The health of Building and Construction fasteners in North America is directly proportional to the health of residential, commercial, and infrastructure activity. Commercial and infrastructure activities usually are committed to over longer time frames and serve as a lagging indicator, meaning that they may be going strong during economic downturns. Once the projects are completed, however, in economic hard times there will be slowdowns in backfilling new projects, resulting in gaps of activity. Initially because of the pandemic, raw material, and labor shortages, a gap in new construction activity may have been expected, however, in the second half of 2020 construction projects, especially residential and infrastructure construction, took off and has not slowed much. This is partially a function of individuals trapped at home due to the pandemic seeking to make improvements and partially because government stimulus provided families with unexpected cash to invest in long dreamed of projects. Additionally during this time period **both the U.S. federal government and many states legislatures passed infrastructure improvement legislation, guaranteeing many large scale, infrastructure projects for years to come.** These projects will be spread out into the future and benefitting construction fastener suppliers for many years into the future.

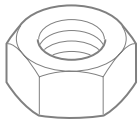
Like the other large market segments, construction fasteners can be further broken down into sub-segment specialties. These include bolts, nuts, screws, washers, structural assemblies, anchors, nails, and threaded rod. It is uncommon for a fastener manufacturer to actually make all of these product categories but rather will specialize in only one or several of these categories. For example, a particular supplier may be a large provider of drill screws but not make a single structural bolt or nut. Even within the sub-categories, there are some producers that may provide only a single “specialty” product such as bi-metallic drill screws, concrete wedge anchors, or direct tension indicating washers.

## Bolts:

Bolts are generally considered to be threaded products which are connected with a free spinning nut. These can have a variety of head styles: square, hexagonal, and hexagonal flange heads. They may be regular hex bolts or heavy hex bolts, **and in North America are usually inch products produced to ASME B18.2.1. For similar metric products they are produced to ISO4014 or DIN931.** In North America, most of these products remain inch so that the subsequent strength grades are Grades 2, 5, and 8 governed by SAE J429 or ASTM A307, A449, and A354 grades BC and BD.



## Nuts:



Free spinning nuts are internally threaded fasteners that are used in combination with bolts to produce the clamped connection. Like their bolt counterparts they come in hex, heavy hex, hex flange, and square varieties. For North America **these are usually produced to ASME standard B18.2.2 for the inch product and ISO 4032 or DIN 934 for metric product. Product strength is generally governed by SAE J995 for Grades 2, 5, and 8, ASTM A194/A194M or ASTM F563/F563M for inch nuts and ISO-898 Part 2 for metric nuts.**

## Washers:



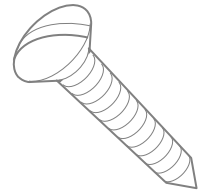
There are a variety of different types of washers available for different applications but generally for construction and building purposes the only washers used are flat washers. **Flat washers are used in construction applications to better distribute load and to span large clearance holes or slots. In North America washers are usually produced to ASME B18.21.1 and to strength requirements governed by ASTM F436/F436M. Metric washers are produced to ISO 789 or DIN 125A.**

A special variant of washers used in construction applications are Direct Tension Indicating, DTI, washers. These are highly engineered, flat washers that have three or four top protruding projections. They are placed in service like a regular flat washer in structural bolting applications, however, when the bolted joint reaches the desired tension, these protruding projections collapse back down level to the top surface of the washer. A special feeler gage is used to verify that the projections have completely flattened signaling that the desired tension has been reached. There are also special versions where the concave underside of these projections are filled with silicon, so that when the projection collapses back in, the silicon is squeezed out providing the installer a positive indication that the projections have collapsed and the proper joint tension is achieved. These products are governed by ASTM F2437/F2437M.

## Screws:

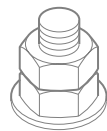
Screws are considered to be products that either thread into non-turning nut members or create their own internal threads. There are several different varieties of screws that are typically used in building and construction. These include:

- Wood Screws
- Sheet Metal Screws
- Drywall Screws
- Deck Screws
- Drill Screws
- Bi-Metallic Drill Screws
- Socket Head Cap Screws
- Timber Screws
- Hex Cap Screws
- Masonry Screws



These screws constitute products used for a variety of building and construction applications. Sheet metal screws are used in metal ducting and HVAC installations. Deck screws come in varieties for both wood and composite materials and are designed to properly fasten exterior decking. Drywall screws come in varieties for both wood and metal structural members and are designed to properly hang drywall. Both deck and drywall screws are often used by installers for general purpose construction applications. This, however, may not always be the best application as these screws may not be optimally designed for these other applications. Drill screws are used to attach metal roofing and building sheathing components. Masonry screws are used for light duty connections to masonry and brick.

## Structural Fasteners:



Structural fasteners are used for connecting iron and steel structures, such as the girders in a skyscraper or beams in a bridge. Structural fasteners are typically sold as an assembly, meaning that the bolt, nut, and washers are sold as a single unit. The reason for this is that these parts usually leave the factory verified to reach a minimum prescribed preload. As such, frictional characteristics must be closely maintained and they do not leave the factory without careful packaging and certification that they will meet the declared performance. In fact, for one special type of structural bolt, Tension Control Bolts, certifying the torque-tension relationship is absolutely paramount. **North American structural fasteners are produced to ASME B18.2.6 and to strength grades A325, A490, A325TC, and A490TC per ASTM F3125/F3125M. Structural bolts are most often used in shear applications, so that they are designed and produced with tighter Full Body Diameter and Grip Length tolerances.** Structural Bolts are usually larger in diameter than general purpose hardware and can actually reach standard sizes as high as 3 to 4 inches in diameter.

## Anchors:

Like screws there are many different varieties of anchors. Anchors are intended to attach construction members to a concrete base. Anchors fall into the following categories:

- Headed Anchor Bolts
- Bent Anchor Bolts
- Drop-in Anchors
- Single Expansion Anchors
- Double Expansion Anchors
- Machine Screw Anchors
- Wedge Anchors
- Epoxy Anchors
- Lag Shields
- Plastic Anchors
- Sleeve Anchors
- Drive Anchors

Headed anchor bolts are just very long headed bolts. Depending on the intended project they might be a foot or two long to many feet long. They are usually hex headed so that when embedded deep into concrete they will not rotate. Bent anchors are similar except that instead of a head on the embedded end, the rod is bent into



a “J” shape. Again, once embedded in concrete, they will not rotate. Both of these types of anchors have to be set prior to the concrete being poured and setting up.

Most of the anchor types listed above are installed after the concrete is in-place. They work on the principle that the anchor will expand into a pilot hole. There are a variety of different ways to accomplish this, but essentially the anchor is either designed to split or to expand once in the pilot hole and generate enough friction against the sides to prevent it from dislodging. These generally work so well that it becomes very hard or impossible to remove once they are set.

Epoxy Anchors are a variety of anchor where a pilot hole is drilled and the anchor is set into an epoxy adhesive. Once the epoxy sets the anchor is locked into place. Drive Anchors refer to the group of anchors that directly connect to the concrete or masonry base. There are a variety of trade named screws that perform this function and require a pilot hole as well as powder driven nails which can be driven right into the masonry substrate without any pilot hole. The strength of the powder charge in the driving cartridge determines how hard of a material the nail can be driven into and how deeply it will penetrate.

### Materials:

Most building and construction fasteners are made of metal. In fact, 93% of construction fasteners are made of metal with the balance being made of plastic. Most of these metal fasteners are made of steel or alloy steel and provided in the as-formed condition or heat treated to increase their strength. Some applications, however, possess more demanding performance requirements and may be made of other metals such as aluminum, brass, copper, silicon bronze, stainless steel, titanium, and, in rare circumstances, nickel super alloys. Like other fastener applications, the users need for improved corrosion resistance, strength, and weight are all decisions points on the best material to use.

### Coatings:

Unlike the automotive industry which uses many different coatings, building and construction fasteners employ only a few common coatings. These include:

- Hot Dip Galvanizing
- Mechanical Galvanizing
- Vapor Galvanizing (Also known as Dry Galvanizing)
- Electroplated Zinc
- Zinc Flake Coating
- Ceramic Coating
- Powder Coating
- Teflon Coating (Also known as Xylan®)

**Hot Dip Galvanizing, HDG, is very commonly used for construction fasteners that are used outdoors.** Hot Dip Galvanizing entails dipping steel parts into a molten bath of zinc. The coating forms several layers with the closest layer to the part being a zinc-iron conversion coating and the subsequent layers being different phases of zinc. The resulting coating is very durable and can withstand many years of exterior service.

Mechanical Galvanizing deposits the zinc layer by pounding zinc onto the surface of the part. Vapor Galvanizing ionizes the zinc and subsequently deposits it onto the steel substrate. This form of galvanizing is generally considered to perform similarly to Hot Dip Galvanizing. Compared to HDG, electroplated zinc does not stand up as well to rigorous environments, but is very commonly used on general purpose construction screws and those employed in interior environments. Zinc Flake Coating, also sometimes referred to as Dip Spin Coatings are paint-like coatings that are highly impregnated with fine zinc or aluminum particles. These finishes can be varied to provide moderate to excellent corrosion protection and have been steadily gaining in popularity for construction and building uses. Finally, Teflon coatings have long been used in certain construction and building applications for both their torque-tension and corrosion protection benefits.

### Summary:

The North American Construction fastener market segment is one of diverse products and rich potential. Although not the largest in size, it is still about a two billion U.S. dollar market, representing excellent opportunity for both existing and potentially new suppliers. It also has the attractive quality of having many different types of parts, shapes, and sizes to provide those interested in this segment with multiple opportunities to find a niche that fits their capabilities well. □

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