

# EXTRUSION Builder News

The **Fastener Issue**

Spring **2015**  
NEWSLETTER

## An Introductory Guide To T-Slot Fastening Options

**Fasteners**  
**T-Nuts**  
**Bolts**  
**Anchors**

**Plates**  
**Brackets**  
**Connectors**  
**and much more...**

*The Newsletter For T-Slot  
Extrusion Builders*



**INDUSTRIAL  
SOLUTIONS, INC.**

**ExtrusionBuilder News** is a free newsletter targeting all types of people that build frames using T-slotted aluminum extrusion. It is designed to be both helpful and informative for both professional builders/assemblers and “do-it-yourselfers”.

ExtrusionBuilder News is published by F&L Industrial Solutions, Inc. - a designer and builder of professional industrial automation framing using T-slotted aluminum extrusion. F&L Industrial Solutions uses 80/20's line of aluminum extrusion, and is a full-service authorized 80/20 distributor. We feel 80/20 offers the largest, most complete line of T-slotted extrusion in the world, with the highest quality at the best price. So even though you may find references to 80/20 T-slot profiles and components throughout this newsletter, most information should be applicable - even if you use a different brand/line of T-slotted aluminum extrusion. Our goal is to write this newsletter in a way that it is useful for everyone that builds with T-slotted aluminum extrusion. Enjoy!

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# FASTENERS OVERVIEW

The variety of fasteners for T-slotted aluminum profiles is immense, and 80/20 is no exception with over 20 types and 400 variations. But for this article, we are going to focus on the most popular types of fasteners. Learn about their attributes and how to use them, and you'll be off to a great start on your path towards becoming a professional T-slot extrusion builder.

Some key things to keep in mind when selecting a fastener:

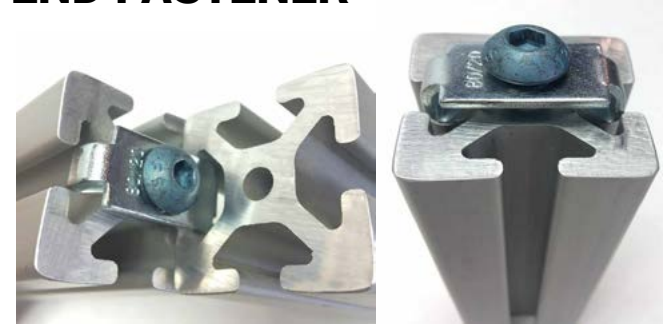
- Functionality of the fastener
- Strength of fastener
- Machining requirements to use fastener
- Cost of fastener & machining



In this overview, we will cover popular fastener types using multiple aspects of usage, so you can compare fastening options while you learn them. Before moving on to the in-depth explanations of individual fasteners, study the pictures and names on this page to familiarize yourself with the names and general look of each fastener type.

**Bolts & T-nuts:** While bolts and T-nuts can be used to fasten bars together, they are mostly used to mount items to the t-slotted frame. The number and variety of bolts and T-nuts is very large, so we have included a basic overview of T-nut fastening options beginning on **Page 10**.

## END FASTENER



End fasteners are composed of a button head socket cap screw (BHSCS) and wing clip. They are one of the most common fasteners as they are hidden and very strong.

## BUTT FASTENERS

Butt fasteners are a type of anchor fastener that is used for connecting two bars together, end to end. Like anchor connectors, they can be inserted and tightened from the side using a ball head hex wrench.



## CENTRAL CONNECTORS

Central connectors are used when you need to fasten two bars together using an internal fastener, but do not want to obstruct the slot. Central connectors are used from the side of the bar and leave the slot free for panels or other items.



## 90° INSIDE CORNER CONNECTORS

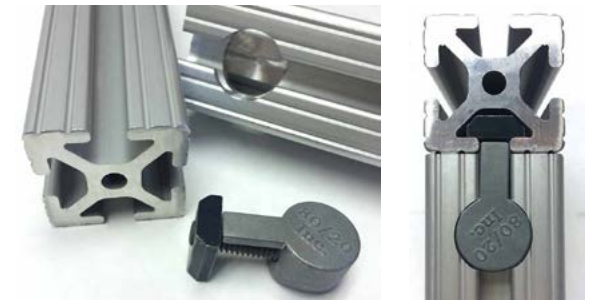
Inside corner connectors are one method of connecting bars that does not require machining. They are relatively hidden versus plates, brackets or gussets. However they do require special notching if used with panels that fit into the slot. They include a threaded corner hole to mount panels that mounted inside the frame, but not in the slot.

## CORNER BRACKETS

Corner brackets are popular for fastening bars together for prototyping, as they require no machining. They are also popular for adding addition strength to any connection using internal fasteners. They come in many different sizes and use standard T-nut/bolts to attach to the T-slot of a bar.



## ANCHOR FASTENER



Anchor fasteners are composed of a socket head cap screw (SHCS), anchor cam, and T-nut. Like end fasteners, they are a very common fastener as they are hidden and very strong. But they also can be used when some adjustability is desired.

## HIDDEN CORNER CONNECTORS

Hidden corner connectors are the least visible fasteners that need no machining. They are great for frames that do not need a great deal of strength.



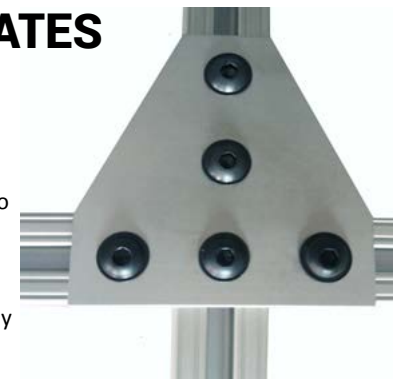
## MITER CONNECTORS

Miter connectors are excellent for joining two bars when they are at unusual angles to each other. They also do not interfere with the internal slot, so they are great to use with panels that fit in the slot.



## JOINING PLATES & STRIPS

Joining plates connect and strengthen any frame. They do not require machining, so they can be used for prototyping. But larger joining plates do require many bolts/T-nuts, so usually they are added last.



## GUSSETS

Like corner brackets, gussets require no machining, so they are great for test builds and prototyping. Gussets are stronger than corner brackets, and give any frame both strength and a super industrial look.

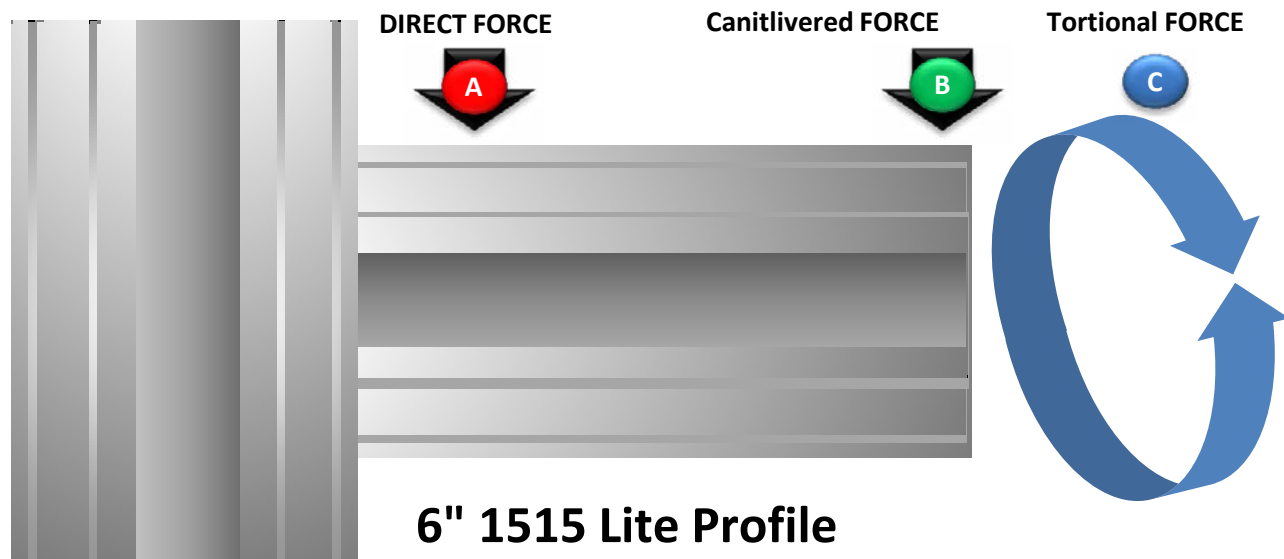


# FASTENER STRENGTH

While the methods to connecting aluminum bars together are endless, specific connectors have been developed over time to offer convenience, flexibility and strength to frames. The chart below outlines the strengths of specific fasteners for direct, cantilevered and torsional force. As you can see, end fasteners and anchor fasteners offer substantial up/down, in/out strengths, while plates offer the best torsional or twisting strength. Although the test results below were conducted on a 1515-Lite profile, the results are similar for most bar types. If the application you are designing for will be subject to both direct/cantilevered and torsional loads, then a combination of fasteners and plates is probably warranted. During the design phase of any framing project, it is vitally important to know what the frame will be subject to in terms of weight and forces. Once you know that, you are on your way to picking the right fasteners for your 80/20 framing project.

Fastener Strength	1515-Lite Profile			
	<b>A</b> Direct Force (lbs.)	<b>B</b> Cantilevered Force (lbs.)	<b>C</b> Torsional Force (lbs.)	Avg.
Single Anchor	950	625	540	705
Double Anchor	1200	700	1150	1,017
End Fastener	1000	500	680	727
Joining Plate	225	200	1000	475
90° Joining Plate	250	200	1120	523
Corner Bracket	375	225	500	367
Corner Gussett	375	750	500	542
Inside-Inside Hidden Corner	50	50	50	50
Inside-Outside Hidden Corner	240	220	240	233

single fastening method      best single fastening method      90° joining plate best single fastening      anchor & end



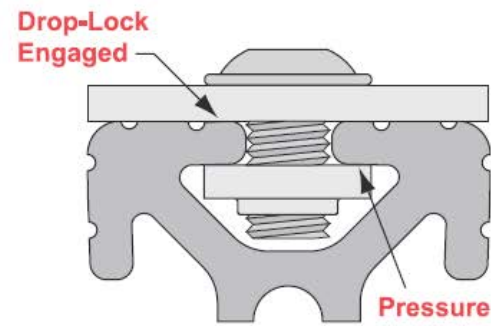
# FASTENER UTILITY CHART

Connector Type	Hardware Costs	Machining Costs	Total Costs	Visibility	Flexibility	Strength
2 Hole Inside Corner Bracket	\$4.15	NONE	\$4.15	●	●	●
2 Hole Joining Strip	\$4.65	NONE	\$4.65	●	●●	●
Hidden Corner Connectors	\$5.15	NONE	\$5.15	●●●●●	●●	●
End Fastener	\$1.60	\$3.90	\$5.50	●●●●●	●	●●●●●
2 Hole Inside Gusset	\$5.50	NONE	\$5.50	●	●●	●
Anchor Fastener	\$3.15	\$2.60	\$5.75	●●●●●	●●●●●	●●●●●
90° Inside Corner Connector	\$6.30	NONE	\$6.30	●●●●●	●●	●●
4 Hole Inside Corner Bracket	\$6.70	NONE	\$6.70	●	●	●●
4 Hole Joining Strip	\$7.35	NONE	\$7.35	●	●	●●
4 Hole Inside Gusset	\$8.65	NONE	\$8.65	●	●●	●●
Central Connector	\$4.55	\$4.20	\$8.75	●●●●●	●●●●●	●●●●●
6 Hole Joining Plate	\$9.45	NONE	\$9.45	●	●●●	●●
Miter Connector	\$4.50	\$5.00	\$9.50	●●●●●	●●●●●	●●●●●
Butt Fastener	\$7.65	\$5.20	\$12.85	●●●●●	●●	●●●●●
9 Hole 90° Joining Plate	\$14.15	NONE	\$14.15	●	●●	●●●
12 Hole 90° Joining Plate	\$20.10	NONE	\$20.10	●	●	●●●●

All prices quoted are authentic 80/20 product MSRPs

# Torque Specifications

- See table below for the amount of torque in foot-lbs. required to activate the 2° drop-lock feature for T-slotted profiles
- Nut and bolt combination is pre-loaded when tightened to the minimum torque rating
- When properly tightened, fasteners will not loosen even under heavy vibration

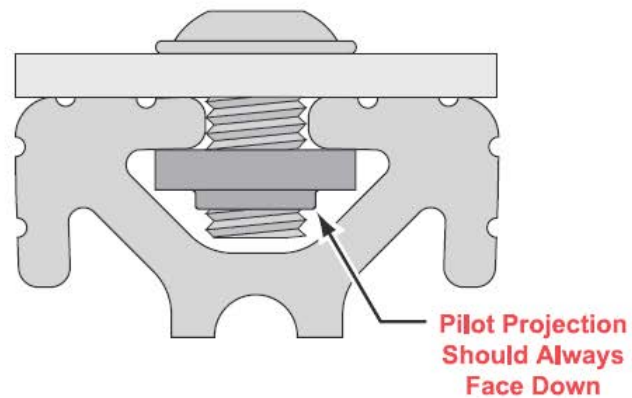


Part Number	Fastener Description	Tested Profile	Minimum Ft-lbs. Torque	Maximum Ft-lbs. Torque
3320	5/16-18 x 11/16 Flanged BHSCS & Economy T-Nut	1515	10.00	15.00
3325	5/16-18 x 3/4 Economy T-Slot Stud, Washer & Hex Nut	1515	25.00	30.00
3360	15 Series Anchor Fastener Assembly	1515-Lite	10.00	20.00
3380	15 Series End Fastener Assembly	1515-Lite	10.00	22.00
3321	1/4-20 x 1/2 Flanged BHSCS & Economy T-Nut	1010	4.00	6.00
3395	10 Series Anchor Fastener Assembly	1010	3.00	17.00
3381	10 Series End Fastener Assembly	1010	4.00	17.00

Assembling T-slotted profiles with 80/20®'s selection of fasteners is a simple and quick process. To ensure a secure connection, there are a few key points to keep in mind when placing fasteners into the T-slot:

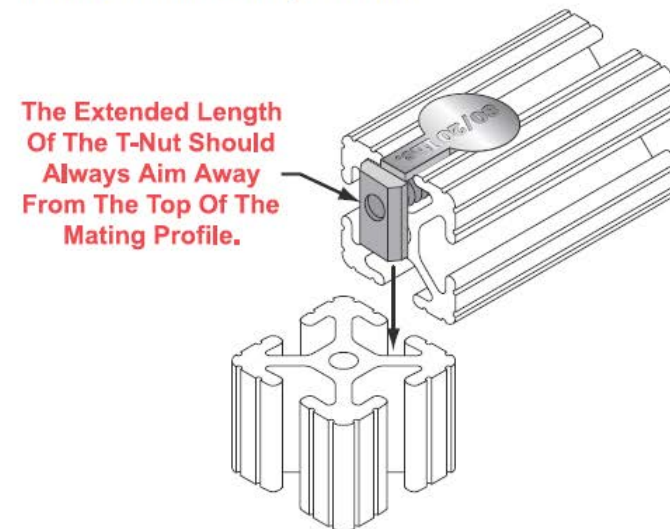
## Threaded Pilot Projection

The threaded pilot projection on T-nuts exists to provide more thread, adding strength to the fastener. Always aim the projection down in the T-slot to avoid crashing and an uneven connection.



## Offset Tap Hole Location

The offset threaded hole on 80/20® T-nuts allows for a flush surface when mating two profiles at a 90° connection. This is most common when using anchor fasteners, as shown in the example below.



# Hardware Finishes

Fasteners and connectors come in several colors/finishes, so make sure when you are purchasing them you order the color/finish you want or need. Some color/finishes have specific properties that make them more advantageous for certain applications, so look at this overview below to better understand what fastener colors and finishes mean to your framing project.

**Black Zinc**  
Black corrosion-resistant coating. Common on many fasteners, bolts and T-nuts. Less expensive than stainless steel.

**Bright Zinc**  
Silver-colored corrosion-resistant coating. Common on many fasteners, bolts and T-nuts. Less expensive than stainless steel.

**Stainless Steel**  
Corrosion-resistant steel that is not a coating, but steel with chromium added.

**Lacquer**  
Coating added to cast aluminum parts to give a more even and shiny appearance.

**Blue**  
Colored zinc coating usually added to metric fasteners to distinguish them from fractional parts with standard zinc coatings. Similar characteristics to zinc coatings.



## Zinc

Zinc coatings prevent corrosion of the protected metal by forming a barrier, and by acting as a sacrificial anode if this barrier is compromised. When exposed to the atmosphere, zinc reacts with oxygen to form zinc oxide, which further reacts with water molecules in the air to form zinc hydroxide. Finally, zinc hydroxide reacts with carbon dioxide in the atmosphere to yield a thin, impermeable, tenacious and quite insoluble dull gray layer of zinc carbonate which adheres extremely well to the underlying zinc.

## Stainless Steel

Stainless steel is defined as a ferrous alloy with a minimum of 10.5% chromium content. The name originates from the fact that stainless steel does not stain, corrode or rust as easily as ordinary steel. This material is also called corrosion-resistant steel when it is not detailed exactly to its alloy type and grade. Stainless steels have higher resistance to oxidation (rust) and corrosion in many natural and man made environments. Stainless steel comes in many different types. 80/20 stainless steel products are usually 18-8 Stainless Steel.

## Advantages of Zinc

- Less expensive
- Less likely to bind/stick over time

## Advantages of Stainless Steel

- More corrosive resistant
- Can be polished to a bright finish
- Harder

# Assembly Instructions

## END FASTENERS

(Access Hole & End Tap Required)



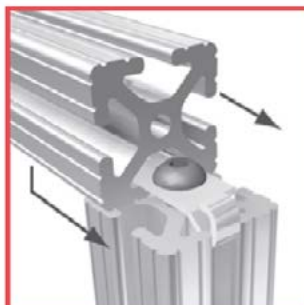
**Step #1:** End fasteners are composed of a button head socket cap screw (BHSCS) and a wing clip.



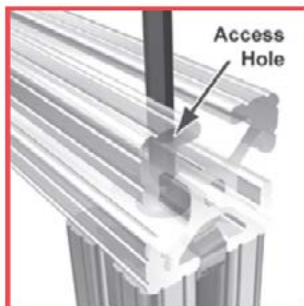
**Step #2:** Pre-assemble by placing the BHSCS through the hole in the wing clip as shown in the photo at left.



**Step #3:** Orient the wing clip in the direction of the mating profile's T-slot. Begin to screw the BHSCS into the tapped hole of the mounting profile. (Do **NOT** fully tighten)



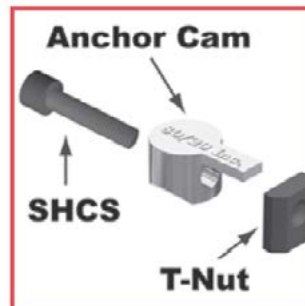
**Step #4:** Slide the mating profile into place. When aligned, the access hole on the mating profile should align with the BHSCS.



**Step #5:** Place a T-handle hex wrench into the access hole until the wrench head inserts into the BHSCS. Tighten clockwise until secure.

## ANCHOR FASTENERS

(Counterbore Machining Required)



**Step #1:** Anchor Fasteners are composed of a Socket Head Cap Screw (SHCS), anchor cam, and T-nut.



**Step #2:** Your anchor fasteners should ship pre-assembled. Slightly loosen the nut and bolt.



**Step #3:** Load the assembled anchor fastener into the counterbore hole. Be sure to position the T-nut with the offset hole oriented toward the top of the fastener. (See photo, Step #2)



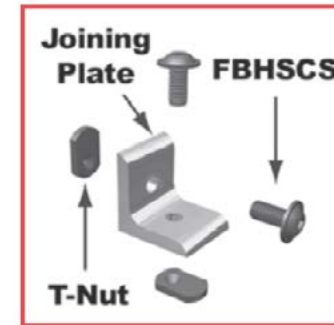
**Step #4:** While holding the anchor fastener in the counterbore hole, slide the mating extrusion into place.



**Step #5:** Square and align the mating profile. Using a T-handle hex wrench, tighten the SHCS in a clockwise motion until the profiles are securely affixed.

## JOINING PLATES

(NO Machining Required)

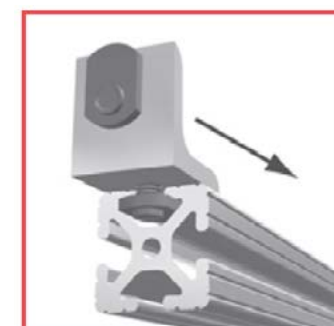


**Step #1:** Joining plates require three main components: The joining plate, flanged button head socket cap screws (FBHSCS), and T-nuts.

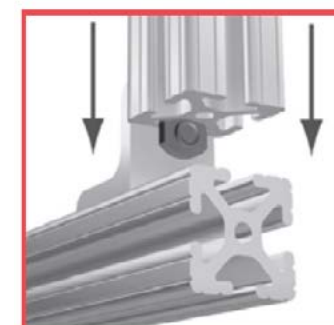


The Threaded Pilot Projection Should Always Face Away From the Plate

**Step #2:** Pre-assemble by placing the FBHSCS through the plate holes and screw into the T-nuts.



**Step #3:** Slide the joining plate into the T-slots of one profile. (Do **NOT** fully tighten)



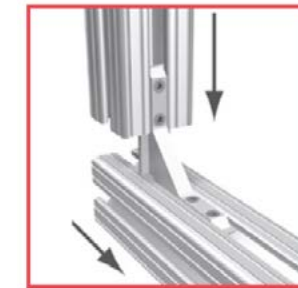
**Step #4:** Slide the mating profile onto the joining plate; square and align both profiles.



**Step #5:** Using a T-handle hex wrench, tighten all FBHSCS until the connection is secure.

## 90° INSIDE CORNER CONNECTOR

(No Machining Required)



**Step #1:** Slide the connector into the T-slot of one profile. (Do **NOT** fully tighten)



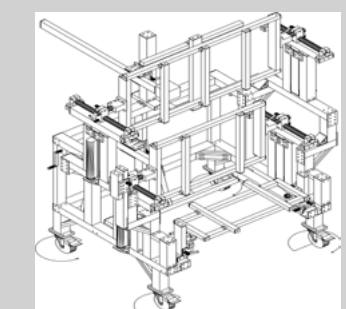
**Step #2:** Slide the mating profile onto the connector, square and align both profiles. Using a T-handle Hex Wrench, tighten all of the bolts until the connection is secure.

## Learn More

Want to learn more about T-slotted aluminum extrusion, more about 80/20 products, more about how to do things, or ready to buy some bars and fasteners and start building?



If you are in southern California, you can arrange for a free Demonstration Van visit to your location to demonstrate the amazing 80/20 product line of T-slotted aluminum extrusion.



If you are not in southern California, don't worry. We can still help you get started using 80/20 extrusions or we can design and build the entire project for you. F&L Industrial Solutions offers full design and build services in addition to the sales of 80/20 products.

[www.fandl8020.com](http://www.fandl8020.com)

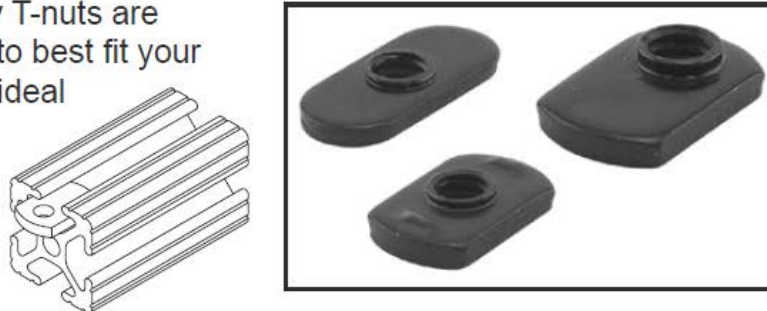
1-858-602-1500

# Introduction to T-nut & Bolt Fasteners

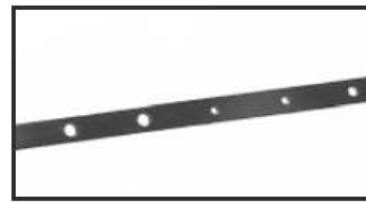
## Introduction to Fasteners

80/20® has the largest assortment of fasteners available in the industry! We stock over 20 types, featuring over 400 variations and combinations for your applications. 80/20 fasteners are made of high-quality materials and hold tight tolerances. Variations include fasteners that load from the profile end or the profile side, fractional or metric, and black zinc, bright zinc or stainless steel material.

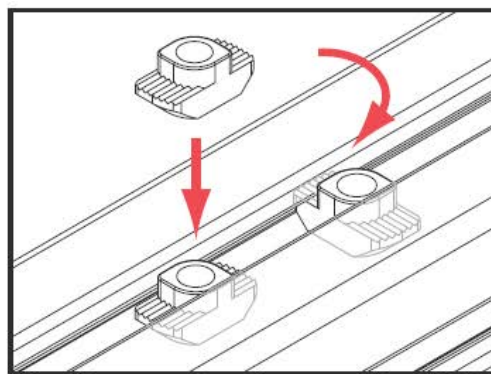
**Slide-In Economy T-Nuts:** single economy T-nuts are available with the thread centered or offset to best fit your application requirements. Offset T-nuts are ideal for making clean end connections without compromising strength. Centered T-nuts work well for connections made in the center of a profile or with a joining plate. Economy T-nuts are also available in double and triple configurations.



Standard **Slide-In T-Nuts**, made of 1215 carbon steel, are high-strength, low-cost fasteners that load from the profile end. They can be customized up to 36 inches in length for any application.



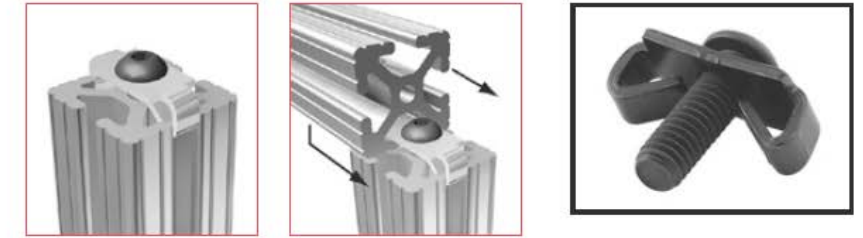
Customized Lengths Available



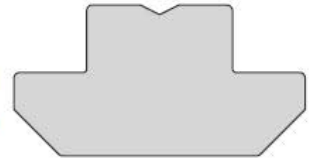
**Drop-in T-Nut** fasteners are a cost-effective, modular choice for most mounting needs. If the profile ends are captivated, drop-in fasteners can be placed directly in the T-slot, then rotated for secure placement.



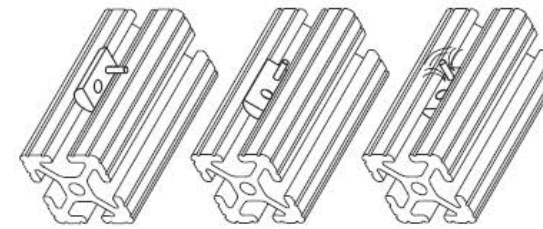
**End Fasteners** provide a strong, square, hidden joint in a fixed location that simplifies assembly. When ordering applications with end fasteners, be sure to specify tapping and access hole machining services for your profiles.



**Self-Aligning T-Nuts** have a raised section that extends up into the T-slot opening. This feature will center the threaded hole of the T-nut in the T-slot, prevent rotation and allow for longer thread dimensions. **Note:** Make certain the "neck" does not extend past the face of the T-slot profile, interfering with the connection.



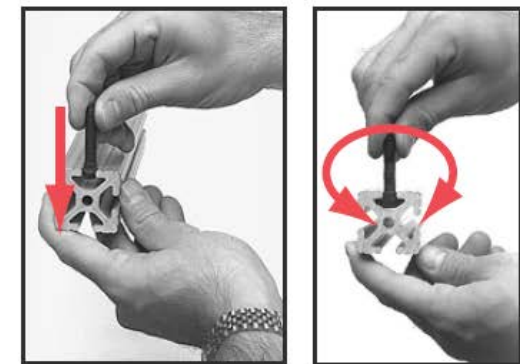
**Roll-In T-Nuts with Flex Handle, Set Screw, Ball Spring or Spring Leaf** load from the profile side, allowing add-ons to your application without dismantling the frame. Roll-in T-nuts with a flex handle, ball spring, set screw or spring leaf hold the T-nut in place for easy positioning. The flex handle makes removal of the drop-in simple.



**Slide-In Economy T-Slot Studs**, loaded from the end of a profile, are the strongest fastener available from 80/20® for use with joining plates. By engaging the Drop-Lock feature, they provide a vibration-proof connection when properly tightened. The square key on the shoulder of the bolt prevents the stud from turning when an application is subjected to vibration.



**Drop-in T-Slot Studs** load from the profile end or into the profile side. If the profile ends are captivated, drop-in fasteners can be placed directly in the T-slot, then rotated for secure placement.



# Common **FASTENER** Mistakes

## 1. Cannot Access The Fastener

Many designers forget to ask where a frame will be built or modified. If the frame is going to be assembled or mounted near a wall, you may have difficulty accessing a fastener that requires a tool to engage from the wall side of the frame. Connectors like anchor fasteners are convenient because they are easily connected without side access, and they are adjustable. End fasteners, central connectors and some plates may require access to all sides of the frame during construction. So be careful that you design a frame that cannot be easily built.

## 2. Fastener Complexity

If you use a lot of different types of fasteners on a frame that will be assembled and disassembled on occasion, you may be setting yourself up for failure. Unless you make meticulous notes when you build your frame, you may forget how to put it together as time passes. Using similar connectors and fasteners throughout the frame makes understanding how the frame was designed easier later in life. Many different fasteners may also require more types of tools, potentially leading to problems. While using different fasteners for different requirements is the right thing to do, too many fastener variations leads to overly complicated designs, and ultimately makes modifying or disassembling the frame more difficult.

## 3. Frame Not Strong

In order to maximize your frame's strength, you must tighten fasteners adequately. As exact torque-tension relationships are affected by numerous factors, most manufacturers including 80/20 do not provide specific torque recommendations. However, most 80/20 fasteners will need between 8 and 28 Ft-lbs. of torque to tighten adequately. Many builders tighten until they hear one or two clear "creaks" that often occur as the drop-lock feature of 80/20's T-slotted aluminum profiles engage (see page 6).

## 4. Frame Not Straight

Assembling your frame true and straight will improve its strength and its look. If you use 80/20's standard profile, it includes the Align-a-grooves surface that helps immensely when aligning or connecting two bars. Some builders use a "square" to help ensure their corners and frames are true before they do the final tightening of the fasteners.

## 5. On-Site Building Perils

Building frames on-site can be risky if everything is not well thought-out. Professional 80/20 distributors that have full-service build teams have all of the machining equipment and inventory to deal with any possible design flaws or issues that can happen during a build, but often do-it-yourselfers will not have those luxuries in the field. While having a drill with you to create an access hole when needed is prudent and so is having extra nuts and bolts, bringing along the ability to cut bars, bore anchor holes or tap center holes may be well beyond most builders while in the field. So before you decide to build something on-site, think about whether building it and bringing it makes more sense - especially if you are having a professional assembly team build it for you at a full-service facility. Even if you are building it yourself, you may be better off building most of the frames in your shop before heading over to the final destination, just in case.

# What's New At 80/20?

**80/20® Inc.**

The *Industrial Erector Set*®



Now available for all of your guarding and other applications where you want your frame to really stick out is yellow powder-coated extrusion - in stock and available sooner than ever!

Yellow extrusion is perfect for any type of guarding, safety, construction, or danger-preventing framing, and it calls attention better than any other color. It really looks good with yellow expanded metal panels!

**MADE IN  
USA**

## YELLOW EXTRUSION!

**Call F&L Industrial Solutions today to order some at 1-858-602-1500**

# DIY Project Showcase - Bike Keg



My girlfriend, now wife, gave me a sweet stretched beach cruiser one year for Christmas. Cruising around Mission Bay and Pacific Beach I started to wonder how to get some of my homebrewed beer do the beach but do it in style. One of the problems is that the bottling stage has come and gone, it's nothing but kegs now. Why not make a bike trailer that can hold a keg on ice, a CO2 tank, have a cup dispenser, and top it all off with a chrome tower. I didn't something that was lighter than steel anyway. 80/20 was the only logical answer. The only tools that are needed was a chop saw, drill, drill bit, tap, tape measure, common sense, and some patience. The trickiest part was to triple check the layout and cut list to make sure everything would fit perfectly. The frame was made entirely out of 80/20 1" square material. Once the frame was done I stood on it to check it out. It's incredible how strong it was and had absolutely no flex at all. Every inch of the 80/20 was square and flat. Between the brackets that are available, and how well the center hole can be tapped for a 1/4-20 bolt, assembly was smooth and easy. Mounting the diamond plate was easy and even mounting the round surface of the cup dispenser wasn't a challenge. The only sad part of the story is that they outlawed drinking on the beach about 2 weeks before it was complete.



## Show Us Your Projects

Send us photos and a brief description of your 80/20 project and you might be featured in an upcoming edition of EBN!

*Photos and story submitted by Keith Simpson of San Diego*

## Upcoming Events



Del Mar Electronics  
**DMEDS**  
& Design Show

Visit Us At  
**Booth #704**

Exposition & Seminar Program  
May 6th, 2015 - 10 AM - 5 PM  
May 7th, 2015 - 10 AM - 3 PM  
Del Mar Fairgrounds, San Diego, CA

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