

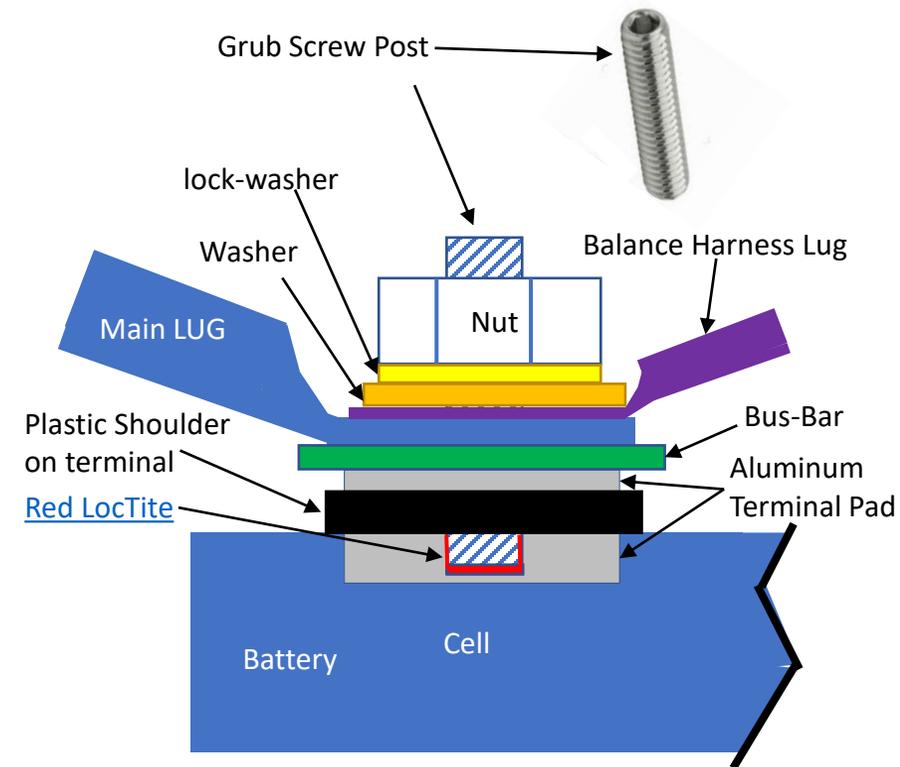
Rules of Thumb for lugs on posts

A few comments about Torque:

1. Every terminal has a different torque spec and you need to be sure the post is torqued to that value. Failure to do so is likely to cause a resistive connection. At best, this results in a voltage drop. At worst it results in a fire hazard. (Unfortunately, it may take some research to find the proper torque for a particular situation)
2. If there is access to both the bolt head and nut, you can get away without a torque wrench and just make it 'really tight'. In all other conditions, a torque wrench is advised.

Lugs On Prismatic LiFePO4 cell Post

- The order of the items (Bottom to top)
 1. Bus Bar (Bottom)
 2. Main Lug
 3. Balance Harness Lug
 4. Washer (This spreads the force down on the lug over a broader area)
 5. lock-washer (This keeps the nut from loosening)
 6. Nut (Top)
- Never put more than one main lug on a cell terminal. (Too much stress on the terminal)
- The primary current path is through the flat surfaces of the Pad and Lug
 - The Bus-Bar, Main Lug and Balance Harness Lug must all lay flat against each other
 - The Lug hole should match the size of the Grub Screw to maximize contact with the pad. (Do not use lugs with oversized holes)
 - The busbar or main lug should completely cover the Terminal Pad to Maximize contact
 - Lightly steel wool the lug and bus-bar First to ensure good contact.
- I like NordLock or star lock-washers for cell terminals. (Split ring washers can take too much force to flatten.)
- I like Stainless steel for the Grub Screw, Nut, lock-washer and Washer.
- **Do not put the grub screw in and out of the terminal multiple times. Each time you do, it damages the soft aluminum threads of the terminal. Just a few times in and out can ruin the threads.**
Because of this, it is best to put the grub screws in once with [RED Loctite](#) and never take them back out. (Even with the Loctite, always use an Allen wrench to keep the stud from turning)
- All threads of the nut should be engaged with the grub screw threads. If not, get a longer grub screw.
- I do not use the screws that often come with the cells.



Tightening procedure.

- 1) Hand screw the grub screw all of the way to bottom of terminal and then back it off $\frac{1}{8}$ - $\frac{1}{4}$ turn.
- 2) Put on the lugs, washers and nuts in proper order
- 3) With an Allen wrench holding the lug screw in place, tighten the nut to proper torque. **Be careful not to strip out the terminal with too much force.**

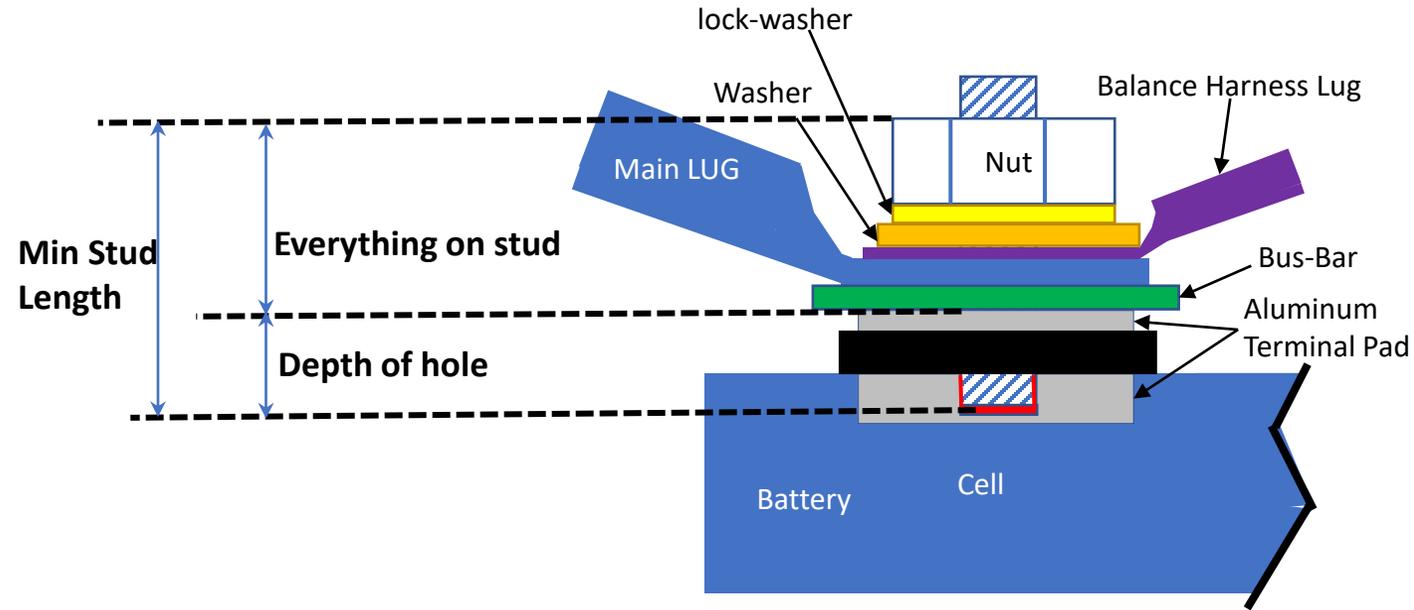
A few comments about Loctite.

- Generally speaking, 'Red Loctite' is considered permanent and 'Blue Loctite' is considered removable. I recommend putting the studs in once with Red Loctite and leaving them there. If there is a plan to remove the stud, I would recommend no Loctite at all. Removing the studs with Blue locktight will likely be worse on the soft aluminum threads than none at all.
- There are multiple types of Red Loctite. Some requires application of Loctite Primer 7649, like the 271, others not. Red Loctite 263 is a good one that does not require the primer.
- Loctite does **not** allow for more torque on the post. Loctite is used to keep the post from rotating, but it does not strengthen the threads.
- The [Loctite tutorial](#) linked to has '533' in the file name. This is **not** referring to Loctite 533 Industrial Adhesive. The document is a nice tutorial about the different uses of the different types of Loctite. It is recommended reading. (Even something as 'simple' as Loctite is not that simple)

Lugs On Prismatic LiFePO4 cell Post (Continued)

Be sure to use studs that are long enough!!

Nut	??mm
Lock Washer	??mm
Washer	??mm
Harness Lug	??mm
Main Lug	??mm
Bus Bar(s)	??mm
Hole Depth	??mm
<hr/>	
Total	??mm (Min Stud Length)



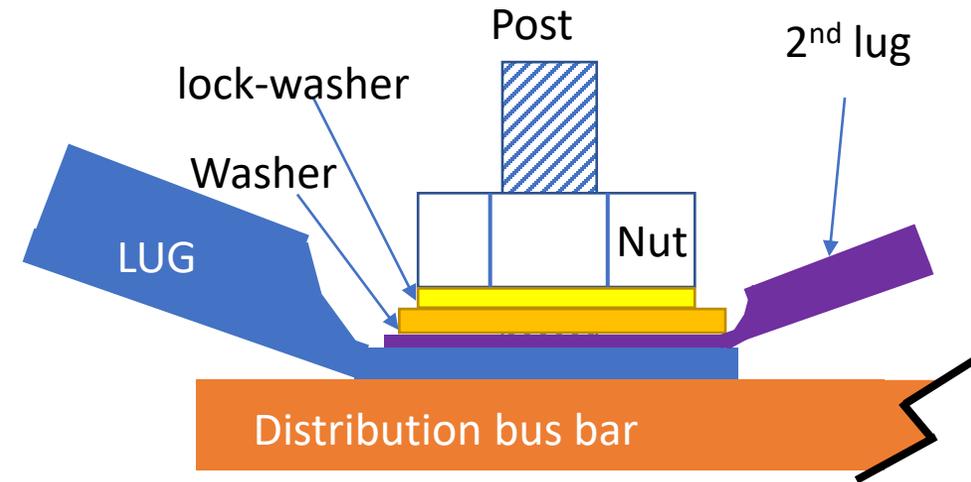
I find 20mm is the min size with factory bus-bars but I need 25MM with my custom thick bus-bars.

The picture to the right is a 20mm stud with two factory bus-bars, lug and harness lug. The stud is just barely long enough.



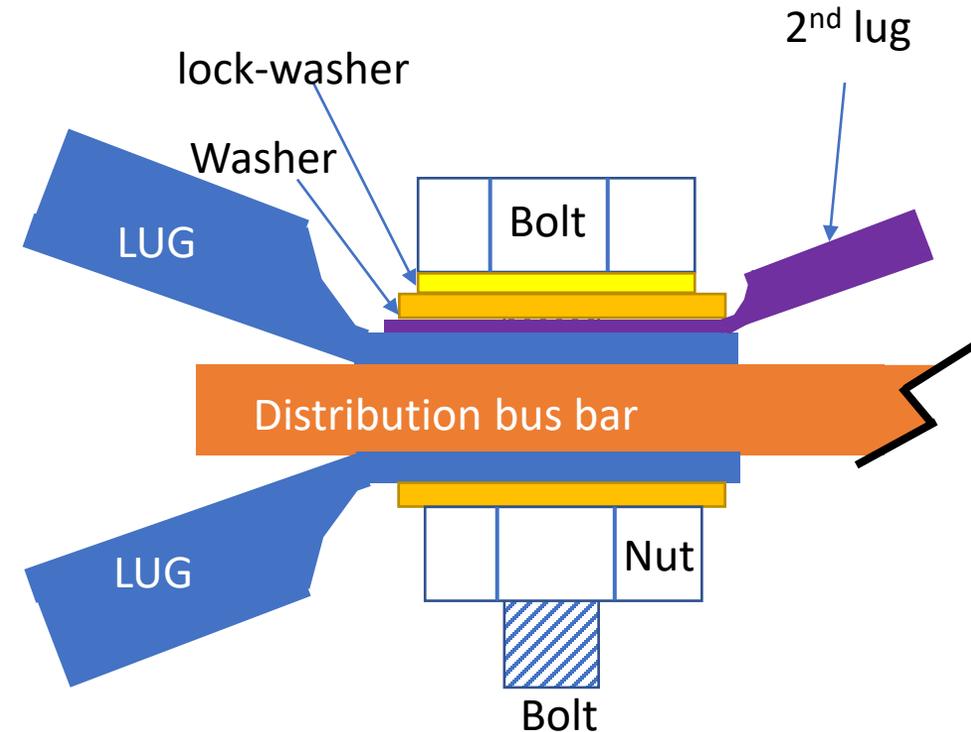
Lugs on Distribution Bus Bars.

- The order of the items on the post (Bottom to top)
 1. Highest Current Lug always goes on first.
 2. 2nd Highest Current Lug
 3. Washer
 4. lock-washer
 5. Nut (Top)
- I avoid Stacking 2 lugs on a post and I really do not like putting 3 lugs on a post.
- The primary current path is through the flat surfaces of the Distribution Bus-Bar and the Lug
 - The lugs must all lay flat against each other and the Bus-bar
 - The lug hole should match the size of the post to maximize contact with the Bus-Bar. (Do not use lugs with oversized holes)
 - I like to lightly steel wool the lugs and bus bar first to ensure good contact.
- I like stainless steel for the nut, lock-washer and washer.
- All threads of the nut should be engaged with the post threads. If not, you are putting too many things on the post.
- If possible & reasonable, put high current lugs on adjacent posts and lower current lugs further out. This minimizes the resistance for the high current path(s)
- Be sure to tighten to the specified torque for the Bus Bar.



Through Hole Bus Bars

- Some bus bars use a nut and bolt with a through-hole on the bus-bar. One nice feature of through hole bus-bars is that a 2nd lug can be put on the opposite side of the first without 'stacking' lugs.
- The order of the items on the post
 - Side 1
 1. Highest Current Lug always goes on first.
 2. 2nd Highest Current Lug
 3. Washer
 4. lock-washer
 5. Bolt (through everything)
 - Side 2
 1. Highest Current Lug always goes on first.
 2. 2nd Highest Current Lug
 3. Washer
 4. lock-washer
 5. Nut
- I avoid Stacking 2 lugs on a post and I really do not like putting 3 lugs on a post.
- The primary current path is through the flat surfaces of the Distribution Bus-Bar and the Lug
 - The lugs must all lay flat against each other and the Bus-bar
 - The lug hole should match the size of the bolt to maximize contact with the Bus-Bar. (Do not use lugs with oversized holes)
 - I like to lightly steel wool the lugs and bus bar first to ensure good contact.
- I like stainless steel for the nut, lock-washer and washer.
- All threads of the nut should be engaged with the bolt threads. If not, you are putting too many things on the bolt or you need a longer bolt.
- If possible & reasonable, put high current lugs on adjacent posts and lower current lugs further out. This minimizes the resistance for the high current path(s)



Lugs On 'Drop-In' LiFePO4 Batteries.

The terminals on Drop-In LiFePO4 batteries vary too much to generalize how to connect your lug to them. However, there are a few rules of thumb that can be applied to almost any type post.

- The terminals on the LiFePO4 batteries vary significantly in quality. Some of them have solid terminals that hold quite well, others have somewhat flimsy terminals so be careful with them.
- Avoid putting more than one main lug on a battery terminal. (Too much stress on the terminal)
If you do put more than one lug on the battery post, the highest current lug should go first so it has the best contact with the battery. I would never put 3 lugs on a battery terminal.
- The primary current path is through the flat surfaces of the Lug and the flat part of the battery terminal.
 - The Main Lug must lay flat on the 'flat' of the battery terminal.
 - The Lug hole should match the size of the post on the battery terminal in order to maximize contact with the terminal. (Do not use lugs with oversized holes)
 - Lightly steel wool the lug and terminal First to ensure good contact.
- It is best to have a washer, lock-washer and nut holding the lug down (In that order). This produces the most even force down on the lug and ensures the nut does not come off. (Even in a stationary system thermal expansion and contraction can loosen the nut)
- I like Stainless steel for the nut, lock-washer and washer.
- All threads of the nut should be engaged with the battery post threads. If not, you have too many lugs on the post.