Three Tightening Procedures Checklist

Depending on the kinds of forces that are acting on the joint and how critical it is to prevent any movement or separation, there are three tightening procedures that take advantage of the pin and spring characteristics of bolts. They are snug-tight, pre-tensioned, and slip-critical.

Below is a checklist of the information you need to know for all three tightening procedures.

Note that some specifications described in the following content may not be the same as the specifications followed by your agency. Always check with your State agency's standards and specifications when using these guidelines.

Sections

- **Snug-tight Joints**
- **Pre-tensioned Joints**
- **Slip-critical Joints**

Snug-tight Joints

- ❑ **Joints tightened by this procedure are sometimes referred to as "bearing type" because the plies of the joint slide until they rest or "bear" on the bolt, acting as a pin.**
- ❑ **A snug-tight connection is defined as the tightness attained by the full effort of a man using a common spud wrench or by a few impacts of an impact wrench.**
- ❑ **The bolt acts as a pin, resisting sliding of the joint with its body. There is no need for high bolt pre-tension, just enough to keep the bolt in place.**
- ❑ **These connections are an example of bearing type joints because the sliding plies bear on the bolt.**

- **Advantages:**
  - Fast and simple, can be done by hand
  - No need for formal inspection or audit
- **Used where:**
  - Shear or compression only, not tension or bending
  - Static loads only, not dynamic loads
  - Low or no vibration
  - Low or no cyclical movement
- **Characteristics:**
  - Goal is to close gaps
  - Threads generally excluded from the shear plane
  - Minimum of five threads inside the grip

Pre-tensioned Joints

- **Joints tightened by this procedure are sometimes referred to as "bearing type" because the plies of the joint slide until they rest or "bear" on the bolt, acting as a pin.**
- **The prefix "pre" means before. In this case, it means before an external or working load is placed on the joint. We pre-tension the joint by tightening the bolt with enough force to resist any separation as external forces are applied.**
- **The bolt acts both as a pin and as a spring as it resists shear movement with its body and also resists tension and bending forces because of the very high clamping force it exerts on the plies. Some amount of slipping from side to side is permitted until the plies butt up against the bolt. The tension is only intended to stop separation of the joint.**
- **Advantages:**
  - Transfers external forces to the joint and does not let them fall to the bolt

- **Used where:**
  - — Shear and tension or bending are present
  - — Dynamic loads are present
  - — High vibration or impact
  - — Frequent or severe cyclical movement
- **When a bolt is properly tightened, external forces (like hitting a pothole or making a high-speed turn) are absorbed by the joint (the wheel in this case) and do not fall to the bolt. If the bolts were loose, the full force of an external shock would fall to the bolt and the bolt would likely break, or some of the loose bolts might come out altogether. This is why we pre-tension.**

Slip-critical Joints

- **This procedure is sometimes referred to as a "friction type" because it depends on squeezing the plies so tight that they cannot slide past one another due to friction.**
- **In this procedure, the joint members do not bear on the bolts as a pin, but are compressed by the bolt acting as a very strong spring. This type of tightening is done where no movement can be allowed because the friction in between the plies can be even stronger than the shear strength of the bolt itself.**
- **The most important tightening method dealing with bridges and similar traffic-carrying structures is the slip-critical connection.**
- **In this connection, the bolt acts as a strong spring—strong enough to create a clamping force so that the friction between the plies keeps any shear movement from happening. This friction resistance is even more effective in keeping the joint stable than the bearing type resistance of the bolt acting as a pin.**
- **In order to enhance the friction between the plies, the mating or faying surfaces (those areas that touch between two plies) have to be roughened or specially coated to keep them from slipping.**
- **No shear movement is allowed in this type of connection.**

- **The tight bolt provides all of the resistance to separation and bending forces that are available in the pre-tensioned joint.**
- **Advantages:**
  - Transfers external forces to the joint and does not let them fall to the bolt
  - Stronger than either snug-tight or pre-tensioned
- **Used where:**
  - Shear and tension or bending are present and no slippage is allowed
  - Dynamic loads are present
  - High vibration and reversing movement
- **If you want to end up with a successful slip-critical (SC) joint, preparation is key. The following are a few preparation rules to keep in mind:**
  - Dry mill scale surface may be acceptable
  - No dirt, grease, wax or lubrication
  - No non-qualified paint overspray allowed
  - Only fully cured dry coatings that meet specifications
  - Hand wire brushing or light grit blasting ok
  - Power wire brushing not approved – may polish instead of roughen
  - Galvanized surfaces need engineer approval
- **Oversized bolt holes require special attention**