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REF: Tools & Fasteners

Torque Wrench Care and Usage, Related Charts and Information



www.Sportsterpedia.com ¹⁾

What Is Torque?

Torque is defined as a twisting force that tends to cause rotation. ²⁾

We call the point where the object rotates the axis of rotation.

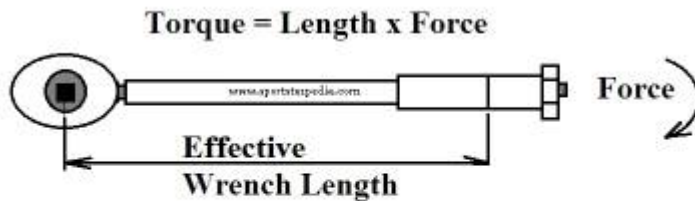
You use torque every day without realizing it.

You apply torque three times when you simply open a locked door.

Turning the key, turning the door knob, and pushing the door open so it swings on its hinges are all methods of applying a torque.

Bolts are often tightened by applying torque to the head or nut which causes the bolt to stretch. The stretching results in bolt tension or preload, which is the force that holds things together.

Torque is measured as effective wrench length times turning force applied.



Handle length usually designated by a marking on the handle sleeve representing center of where hand is placed for pulling. Length changes when sleeve is turned to select the torque value on a clicker wrench.

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Is a Torque Wrench Really Necessary?

- **Best answer is, if there is a torque spec written in the manual, it's best to use a torque wrench on that fastener.**

The torque values are written so you don't break parts while installing things.

Arrogance when wrenching can end up with broken bolts and parts.

Some have the gift of 'feel' and claim to have never broken or stripped a bolt.

That's fine. But not everyone that has a Sportster has the gift of 'feel'.

Getting your education from a broken engine case is expensive and counter-productive.

- Some people strip threads with torque wrenches. It depends on the person using the wrench.⁴⁾ Some people use torque wrenches properly to avoid either under or over-tightening fasteners and other threaded devices.

A torque wrench allows you to know rather than estimate how tight you've gone.

Is it necessary to use a torque wrench on spark plugs?

Not absolutely. It's just a very good method to avoid over-tightening and possibly pulling the threads in an aluminum head.

- Sometimes 'hand tight plus a nudge' is good enough for non-critical fasteners. However, parts like heads and sprockets need a certain clamp load or they will not perform well or even break loose while riding.
- A torque wrench allows you to get near the same clamp load on all the fasteners to a piece (evenly distributing the load). Without a torque wrench, it's easy to tighten some fasteners tighter than others. (like on a cam cover which will end up warping the cover) Heat plays it's own roll on clamp load after you've put the torque wrench up and ride away. The designed clamp load spec takes these things into account.

Torque Wrench Maintenance

The more often a torque wrench is used the faster it will wear or go out of calibration.

Monitoring the number of cycles per day or total hours that a tool is used is the most accurate way to establish proper maintenance intervals. ⁵⁾

- **Any torque wrench should be regarded as a precision instrument.**
 - You are 'trusting' this tool to work properly whether tightening low torque cover bolts or a high torque engine sprocket nut.
- **Do not leave your torque wrench laying around on the floor or chunked in a tool box unprotected.**
 - This will result in it not working properly when you need it to.
- **Do not use a torque wrench as a cheater/breaker bar.**
 - Breaking tension/removing bolts should be done with appropriate tools for the job.
 - This practice can throw a torque wrench out of calibration or damage the wrench.
 - There are other means of leverage tools that can be better used to remove stubborn bolts instead of using a torque wrench.

See [Cheater Bar, Breaker Bar and General Leverage Assistance](#) in the Sportsterpedia.
- **Keep it in a case when not using it.**
 - If it comes with a case when you buy it, keep it in the case when your not using it.
 - If it didn't come with a case, make or buy one.
- **Clean your wrench on the outside with a dry cloth before putting away.**
 - External cleaning fluid or other chemical solvents can corrode the internal lubrication of the tool, causing premature failure.
- **Store it in a dry place.**
 - Condensation can ruin the wrench internals and rust the outside.
- **Disassembling a torque wrench:**
 - If it is necessary to disassemble the wrench follow properly documented instructions provided by the manufacturer or send to a competent technician.
- **Clicker Type Wrench:**
 - **Always reduce the dial to a low setting when not in use.** (detailed in the instructions that should have came with it).
 - Most click wrenches are built with an internal spring mechanism that is compressed to against a lever.
 - Adjustable wrenches use springs that must meet a known length test.
 - After use, the wrench should be turned back to minimum scale value to help preserve the length of the spring and calibration thereof.
 - It is thought (and has been proven) that leaving a calibrated wrench at one setting impacts spring length, disallowing accurate use at other settings.
 - It does not happen every time, but over time linearity can be impacted causing error.
 - This is the reason for the recommendation to turn a wrench back to its minimum setting when not in use.
 - If you use the wrench at only one setting, you might consider a "preset" version that is set at one setting (no scale and is set by a torque tester).
 - It requires no adjustment to minimum and can stay set at one torque setting without issue to linearity. ⁶⁾
 - The ratchet of a wrench should be inspected for wear, cleaned and lubricated.
 - The wrench handle should not be loose and it should be free of corrosion or lubricants when used.
 - Never wrench the tool past the clicking sound.
 - Check any screws or fasteners on the wrench before using it for tightness and that the

ratchet spins freely when turned.

- If you drop it, it's best to check calibration before using it next.

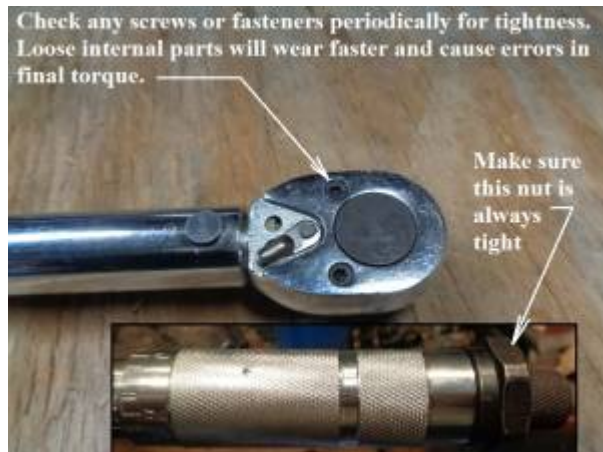
- **Beam Type Wrench:**

- If using the beam type wrench, always check and 'zero' the dial if needed before each use.
- If you drop a beam-style torque wrench and bend the pointer or scale, it obviously won't read accurately.

You can try to bend things back to their original position and check calibration.

But you may or may not succeed in restoring it's accuracy.

- **Torque wrenches are really misunderstood, and if used with blind faith, can be the source of many problems.** ⁷⁾



Related videos:

- [Clicker type torque wrench repair](#) (includes disassembly)

Torque Wrench and Accuracy

Accuracy across multiple bolts across a piece;

Parts with multiple bolts to accomplish clamp force across the entire part (covers, head etc.) require all bolts to end up the same torque.

If everything is done right during the tightening process, you still have wrench accuracy variance on multiple bolts.

So no matter how hard you try, the wrench itself will make it so you won't get the exact amount of torque on all bolts.

They will end with an average amount of clamp force each within a small range from each other based off the certain wrench you are using.

See also this YouTube video on [Snap-on - VS - Harbor Freight \(ICON \) 1/2" Torque Wrenches](#)

In this comparison, the ICON wrench outperformed the Snap-On wrench.

There are many methods for measuring preload.

However, one of the least expensive techniques that provides a reasonable level of accuracy versus cost is by measuring torque.

The table below is from the Industrial Fasteners Institute.

Torque-Measuring Method Comparison.

Preload Measuring Method	Accuracy Percent	Relative Cost
Feel (operator's judgement)	± 35	1
Torque wrench	± 25	1.5
Turn of the nut	± 15	3
Load-indicating washers	± 10	7
Fastener elongation	± 3-5	15
Strain gauges	± 1	20

Technique plays a part in torque wrench accuracy.

Torque wrenches are only as accurate as your ability to use them. Too many people focus just on the factory calibration.¹⁰⁾

There's no doubt that proper calibration is important, but, in reality, your own technique often has a bigger effect on accuracy.

Focusing solely on factory calibration is a bit like worrying only whether your fishing line can hold a 30 pound trout.

The equipment isn't often the limiting factor.

Wrench accuracy matters also.

The accuracy for a torque wrench can be stated in terms of Full Scale (FS) or Indicated Value (IV).¹¹⁾

There is a big difference in result as full scale accuracy indicates the allowable error over the full-scale range of the tool.

Indicated value accuracy indicates allowable error at the set point on the wrench.

Indicated value stated wrenches are more accurate, especially on the lower end of the range.

It is important to determine if the accuracy needed for an application can be obtained with the torque wrench selected.

Example using ± 4% accuracy calibrated wrench:¹²⁾

Fastener torque is 100 ft/lbs

The torque wrench will click to indicate a proper torque somewhere between 96-104 ft/lb.

This accuracy is typical of high-quality torque wrenches and is more than sufficient for normal uses.

The manufacturers of torque wrenches (good quality ones anyway) publish the calibration specs on their wrenches.

So you see, one wrench of the same type can yield different end results depending on wrench accuracy alone.

The table below shows that Full Scale accuracy is less accurate than Indicated Value.

As the tolerance against the scale varies from 5% to 50%, whereas the Indicated Value Accuracy is 5% at each value.

Full Scale (± 5% throughout range)	Percent of Scale (torque)	Indicated Value (± 5% at each value)
95-105	100	95-105
45-55	50	47.5-52.5

25-35	30	28.5-31.5
5-15	10	9.5-10.5

Tips for Maximizing Accuracy:

1. Look carefully. You have to set the torque wrench with your own eyes.
If you accidentally set the dial at 98 or 102 when you mean to set it at 100, you have introduced extra error.
This can happen if you are looking at the scale at an angle. ¹³⁾
2. Turn the torque wrench smoothly.
You have to turn the torque wrench slowly and steadily, stopping when you hear or feel the click (when using a click-type torque wrench, that is).
Turning the fastener past the click means you have applied extra, unintended clamping load.
Swinging the torque wrench rapidly means you might swing right past the click. ¹⁴⁾
3. Pay attention to the conditions under which torque is measured.
If the specs are 120 ft/lb on a dry fastener, don't expect to achieve highly precise measurements when your fastener is greasy or unusually hot.
Depending on the conditions, you might still get quite close. You will have to judge whether close is adequate for your purposes.
Over-torquing can result in broken parts and early deterioration. Under-torquing can result in loose parts, which can fail or come apart unexpectedly. ¹⁵⁾
4. Push on the handle, not anywhere on the wrench body. The torque wrench measures force at the pivot point just below its head.
It has been calibrated so that this force accurately corresponds to the amount of torque shown on its scale.
(only when you apply force on the handle and nowhere else) ¹⁶⁾



Torque Wrench Calibration

[Click here for picks and instructions on Field Calibrating a Torque Wrench](#) in the Sportsterpedia.

Calibration intervals set by national and international standards are either one year or 5000 cycles,

whichever comes first. Or when a visual inspection reveals old or dry grease, parts that show signs of excessive wear, loose or unstable components.

Calibrating a tool involves adjusting the standard readings of the tool by comparison with a standard.¹⁸⁾ The field method in the link above allows for checking the accuracy of the tool.

To have it done right, a torque wrench needs to be recalibrated by professionals.

There are several companies that will recalibrate torque wrenches.

However, sometimes you have to weigh the monetary figures of re-calibration against buying a new one. Custom-Cal provides this service but they have select brands in which they will calibrate. Fee currently (\$40).¹⁹⁾

If you can buy a new one between \$25-\$50, you'll spend more than that in total cost of recalibrating your old one.

However, if you have an expensive torque wrench and want it calibrated, this service is well worth the \$40.

How often should you calibrate your torque wrench? Some factors are below for determining the frequency of calibration.²⁰⁾

Generally speaking, the simpler the mechanism, the less frequently it needs to be calibrated.²¹⁾

1. **How often is it used?** Higher frequency of use = more frequent calibration intervals.
2. **How are you treating the torque wrench?** Dropping it or heavy field use = more frequent calibration intervals.
3. **What conditions is it used under?** Hot, cold, wet or humid conditions may require earlier calibration intervals.
4. **Is it subjected to overload?** If overload is equal to more than 25% of the max it, it may require more frequent calibration intervals.
5. **Note the readings and know when they change.** If readings have a tendency to jump at a certain repetitive point, calibrate sooner.

Selecting the Right Torque Wrench

See [Torque Wrenches and Attachments](#) in the tools section of the Sportsterpedia.

Using a Torque Wrench

Proper torque procedures were used to initially build your bike. Skipping any of the advice below should be done at your own risk.

Many engine tear-downs are the result of too much torque (or hunkering down) on a nut or bolt. Don't let it be you.

These are things you must take into account while using a torque wrench:

- Torque is relatively easy to measure using a torque wrench so it is the most frequently used indicator of bolt tension. ²²⁾
- Unfortunately, a torque wrench does not measure bolt tension accurately, mainly because it does not take friction into account.
- The friction depends;
 - Bolt, nut, and washer material.
 - Surface smoothness.
 - Machining accuracy.
 - Degree of lubrication.
 - Number of times a bolt has been installed.

Set up the torque wrench:

- **Zero the wrench before beginning.**
 - If using the beam type wrench, always check and 'zero' the needle if needed before each use.
 - If using a clicker, always release the pressure on the spring before putting it away. When you get ready to use it, it will already be fully released to the lowest value on the wrench.
Double check that before selecting the desired torque value.

Technique:

- **Let the torque wrench do the work.**
 - Your entire body does not need to be involved when tightening most bolts on a Sportster. An exception would be something like the engine sprocket (or high torque fasteners).
- **Pull from the handle, not the middle or the end nut.**
 - The drive end doesn't know when to click. It is pre-calculated force from the handle working to build force at the drive end.
Pulling from the nut on the end adds more length but creates the same force on the drive end (fooling the wrench to click prematurely).
 - You can also turn the nut by accident which will change the wrench calibration throughout it's torque scale.
- **Always slowly pull (never push on the handle) the tool toward you in a clockwise manner..**
 - You lose control of the torque applied when you push on the handle.
 - If the wrench slips off the bolt/nut, busted knuckles or worse injury to follow.
- **Hand placement and the angle of the wrench is important.**
 - It's common practice to cup the end of the tool with one hand and use a slight pressure against and centered to the bolt/nut.
Then move the wrench handle with the other hand at 90° from the fastener.
 - The wrench needs to stay 90° to the fastener during operation.
 - Any deviation from 90° will lower the amount of torque applied to the fastener to a small degree.
Some say it's not enough of a change to matter, but it is worth noting.
 - Any angle other than 90° puts the load on only one side of the fastener.
That sets you up to possible strip the corners on hex bolts or strip the center of Allen head / Torx head bolts.

- **While applying torque, always use slow even motions.**

Applying torque too fast leads to fooling the torque wrench (and / or your eyes) before torque is actually reached.

Establish a pattern to follow every time to condition yourself not to make a mistake when it's counted.

- The clicker type torque wrench can click too fast or you can end with a temporary visual mistake with a beam wrench ^{23) 24)}
- The 1/4" clicker will go way beyond torque when used too fast.
By the time you hear the click, your still turning which could result in damaged bolts, bolt heads and even cracking the piece your working on.

Pre-torque tightening:

- **Start all of the fasteners in a component before you tighten any of them...**not even hand tight. Any misalignment of the part can side load the last fastener enough to prevent it starting or promote cross threading. ²⁵⁾
- **By hand, all dry bolts should run in rather easily.** If not, there may be trash/ debris caught up in the threading (which can alter you reaching proper torque values). Turn all bolts in sequence by hand until snugged.
- **If you're using thread dressing** (oil, loctite / anti seize, etc.), these will induce drag on the bolt(s). You can use a socket, without the wrench, to turn the bolts to snug by hand. You will also need to reduce the final torque on your fasteners since thread dressings will add pre-load to the threads. This pre-load is added on top of your final torque. You can use the wet charts below as a guide to decide how to adjust your final torque. This will vary on how much and what type dressing is used on the threads as well as proper use of the torque wrench.
- **Align each bolt** chamfer with it's corresponding threaded hole and counter rotate the fastener to the tightening direction a few degrees until you feel the threads "jump", that indicates the threads are aligned to start in sync.
- **Tighten (to snug) all of the bolts the same way around your piece in a cross pattern to ensure evenness throughout.**

Torque the fastener in steps.

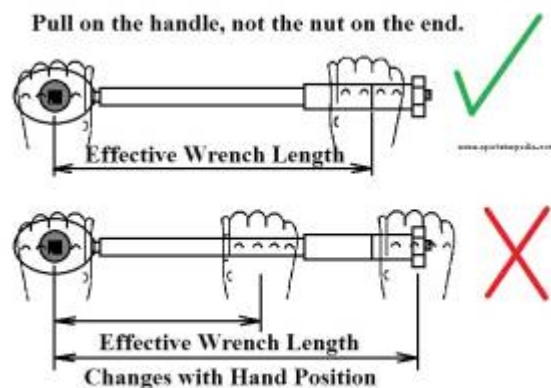
- **Find the torque specs for your application and divide that number by three.**
 - You now have three different torque values:
Unless instructed otherwise by the FSM, start your cross pattern in the center and then move towards the left and then towards the right.
- 1. First number (lowest number) w / cross pattern over the entire number of fasteners on the piece.
- 2. Second number repeat the same cross pattern starting with the same bolt you began with on the first pass (all bolts).
- 3. Final pass (target torque value) repeat the same cross pattern starting with the same bolt you began with on the first pass (all bolts).
- 4. Lastly, go back around with the final torque to make sure everything is relatively even.
 - There is no reason to re-torque heads. If you made it to final torque and everything went Ok, you can do more harm than good on re-torque.
 - At this point, your mainly insuring that you didn't miss a bolt when making the rounds. It's better to know now rather when your on the road.

Wrench type specifics:

- Beam wrench:
 - As you pull tighter, you will notice the handle bend slightly. This calibrated bending is the result of applied torque. Watch the end of the needle located just above the handle. As the beam bends, the needle points to the amount of torque being applied.
 - Continue to turn the fastener, and allow the handle to rotate so that the pivot is the only thing contacting the beam. Some handles have a pivot piece that you actually are holding. Arrange it so the handle 'floats' with you instead of cocking sideways against the bending beam.
 - Keep your eyes looking straight at the center bar end and the torque scale. It's hard to impossible to judge when the pointer is on the right value looking from the side.

two fasteners	
① 1A → 1B → 1C → 1D	② 2A → 2B → 2C → 2D
four fasteners	
① ④ 1A → 3A → 1B → 3B → 1C → 3C → 1D → 3D	③ ② 2A → 4A → 2B → 4B → 2C → 4C → 2D → 4D
six fasteners	
④ ① ⑤ 1A → 3A → 5A → 1B → 3B → 5B	③ ② ⑥ 2A → 4A → 6A → 2B → 4B → 6B
1C → 3C → 5C → 1D → 3D → 5D 2C → 4C → 6C → 2D → 4D → 6D	
General Torque Sequence for Multiple Fasteners A- snugged by hand C- second torque value B- first torque value D- third to final torque value	

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Using "Feel" While Tightening

See also, [Strengths Of Various Fasteners](#) in the Sportsterpedia.

You may hear people say that they don't need a torque wrench because they can 'feel' when a bolt/nut is tight enough.

The 'feel' can't be taught. It comes with experience (and many previously broken bolts in the past).

That's right, people that say that have broken many bolts in order to get the 'feel' when enough is enough.

If you don't possess the 'feel', please, use a torque wrench on your Sportster until you develop a feel for tightening.

- Most of this applies to any wrench. ²⁸⁾
1. **First, you can't feel anything by swinging a torque wrench or any other kind of wrench too fast.**
 - The best way to approach tightening a fastener is to snug it up by hand (in a cross pattern on multiple bolt fastening).

- Then use slow pulls while tightening.

2. If you turn the wrench slow and consistent enough, sometimes you can feel changes in the pull.

- While tightening, the whole affair will get tighter consistently. The pull will be will get progressively tighter.
Then, there comes a point where the nut / bolt seems to hold tighter than before.
That plus a nudge is usually good enough for most fasteners.
If it doesn't FEEL right, it probably isn't.
- If using a beam type torque wrench, you've already checked the spec and know where to stop.
That's where you start paying more attention to the numbers on the beam torque wrench.
- If you have a clicker type torque wrench, that's the point where you wonder when it's going to click.
If, turning just past that point, it doesn't click, then it's probably good enough.
- The 1/4" clicker clicks softly on the lower end of it's scale. The 3/8" clicker will at times also. It may be only slightly audible. Sometimes you can feel the vibration when it clicks but can't hear it.
- The 3/8" and 1/2" clickers are used with more torque and spring pressure and will usually click harder / louder.
But again, if used on the low end of their scale, they can fool you with only a slight audible click or not at all.
Anticipate the vibration when it clicks.
- Some have the need to keep pulling until it clicks.
If the wrench is not accurate for whatever reason, the click won't happen, damage to follow.

3. The last pull needs to slowly come to a stop on the correct value.

- If you get close but not quite there and stop, it takes more torque to make the bolt turn from that spot.
- That could end in over-torque due to the force needed to move the bolt from there.

4. If you're pulling and all of a sudden you realize it's not getting tighter, but you are still turning;

- Sometimes you can stop there, back out the bolt and replace it.
That usually means the head is spinning but not tightening, or about to spin off.
- A bolt will stretch. They are made to stretch.
But there comes a point where the stretch gets more than the bolt is built to handle.
That's the yield point. Over that and the threads strip or the head will break off.
You can actually feel this happening. That doesn't mean it won't, but you can feel it.
Remember that "feel" on the next bolt and be cautious not to let it happen again.
- If it was a auto V-8, usually the worst to happen is drilling the bolt to use an easy out to extract what broke off in the part.
If on a Sportster engine, the worst comes down to splitting the cases to weld it back.
It's that simple.

5. Longer bolts (I.E, Evo head bolts) are prone to twisting in the middle. You can tell when this happens and before it's too late.

- If you are pulling with a beam and notice the more you pull, the dial doesn't get any higher;
Then let the wrench come to rest and watch the bolt head twist back on you.
The bolt has stretched beyond yield but hasn't snapped yet.
It flexes back to it's resting position.
If you are pulling with a clicker, and don't pay attention to the feel;

It won't click since the clamp force will not reach that high as the bolt is twisting...
Snap goes the bolt.

6. Thread dressings (oil, Loctite, anti-sieze etc.)

- If you have thread dressing applied to the threads and pull to the specified torque value, then you have over-torqued the bolt.

All thread dressings lock into the valley between the threads and preload the torque.

Check out the wet charts below. They are surprising.

- With grease on the threads, the fastener will slip more easily against the material in which it is turning. ²⁹⁾

It won't feel tight enough even as it is clamping down with greater and greater load as it turns.

7. Torque Wrench Size:

- Quote from Toejam503 of the XLFORUM:
 - I've always found that the lower end of the scale on a foot pound torque wrench isn't accurate enough for something rated in inch pounds.

100-120 in/lbs has a lighter pull than 10 ft/lbs on a 150 foot lb torque wrench. ³⁰⁾

- You bet it does.

Ever notice an in/lb wrench is smaller, especially shorter, than a ft/lb wrench?

There is a leverage difference in the size of a wrench.

This goes to the concept of 'feel' as well.

- A smaller torque wrench will allow you to feel more than a larger one.

Flipping back and forth between beefy and wimpy wrenches of the same fastener size can confuse the sense of feel.

Ask yourself which 9/16" open/box end wrench you prefer, the short one or the longer thicker one?

The beefier ones give you more power for the pull and helps keep from bruising your hands more on high torque.

But the smaller ones allow you to feel more of the pull.

So it's a balance based off your strength and resilience as to which is the best to use when practicing "feel".

Will Using Extension / Adapters Change Torque Applied?

- Socket extensions to lengthen the distance vertically from the drive end to the socket do not affect the accuracy of final torque.

That is if they're used properly, and you're using your torque wrench correctly. ³¹⁾

- You're applying a torque at one end, and the bolt is applying a counter-torque at the other end.

If the extension is not in the process of being twisted to a greater extent than it already has been,

then the torques at both ends must be the same in magnitude but opposite in direction.

(If the torques were not equal, the extension would be twisting more.)

Then by Newton's third law (more or less),

the torque being applied by the socket to the bolt is the same as (but opposite) as the counter-torque being applied by the bolt to the socket. ³²⁾

- However, extending the length of the drive end will affect final torque if not kept at 90°.
- To get an accurate reading from a torque wrench, you must:
 - Place your hand in the correct spot.
 - Maintain the torque wrench parallel to the fastener at all times.
 - Avoid any wobble or universal (swivel) sockets.
 - Use a quality torque wrench that has been calibrated recently.

See further explanations on using extensions below.

Drive Extensions (horizontal to the wrench)

- **An extension that increases the length of the wrench at the drive end will change the final torque applied.**
 - These are usually considered methods to extend the length of the wrench (in a linear plane).
 - There are some spots where a torque wrench head is too big or awkward to go.
 - It may be necessary to extend the drive center to get into confined spaces.
 - Extending the drive end adds extra leverage (torque) on the nut / bolt.
 - So you'll have to lower the setting on the wrench to compensate.

- **An extension used at 90° from the drive center does not change the length of the wrench or the final torque applied.**

It does not matter how long your extension is as long as it's kept at a 90° angle and the length of the torque wrench, length (L1) below, isn't changed.

- A crows foot, for example, used straight out from the wrench does change the final torque.
- A crows foot used (and kept) at 90° from the wrench does not change the final torque.

Calculation for Length Extensions

- **Measurements:**
 - Torque is measured at the socket (drive center) axis.
It does not depend on the length of the wrench handle.
That only affects the amount of pressure you have to exert to achieve a particular torque.
 - The extension is measured from drive (center) axis of the torque wrench to the socket (center) axis of the torque wrench. ³³⁾
- **Calculations:**
 - The calculation is the same for all types of torque wrenches (whether clicker or beam type, etc).
 - You can search online calculators to find the value to set your torque wrench to achieve actual torque at the fastener.
 - Norbar's torque wrench extension calculator is now available as an app to download free on iPhone and Android.
The torque extension app calculates the exact torque wrench setting value for required level of torque to be applied.
 - When you put an extension on a torque wrench drive end (e.g. a crow foot or a dog bone) the

torque applied to the fastener increases as the lever arm extends.

The calculator will work out what value you should set into the wrench to achieve the required fastener torque.

- **The following formula has been used:**

$$M1 = M2 \times L1 / L2$$

- M1 is the torque setting of the wrench.
- M2 is the actual torque applied to the nut.
- L1 is the normal length of the wrench (Total Effective Length).
- L2 is the extended length of the wrench (Total Effective Length).

Example: ³⁴⁾

M1 = ?

M2=80 ft/lbs

L1=18"

L2=22"

Calculate: $80 \times 18 / 22 = 65.45$.

Therefore if you want to torque a fastener to 80 ft/lbs using an 18" torque wrench with a 4" torque extender, you will set the wrench to 65.45 ft/lbs.

Socket Extensions / Adapters (vertical to the wrench)

- **Socket extensions or adapters do not change the length of the drive (center) axis or the final torque.**
 - Socket extensions come in a variety of drive sizes and lengths.
 - You can use them connected together for extra long extensions and they will not affect final torque.
 - However, if you add a swivel on the end of the extension, the final torque may end up slightly lower than the preset value on the wrench.
- **Step-Down Drive Adapter.**
 - Torque wrenches come with a variety of drive point sizes. Of course, so do sockets. Unless you have a full shop of tools, it can be cost effective to use drive adapters. These give you the flexibility in using the same sockets with different drive wrenches.
 - It's also important at times to be able to get to certain spots with smaller O.D. wrenches with the help from adapters as a (1/4" drive) 1/2" socket will probably be a smaller outside diameter than 3/8" or 1/2" drive in the same bolt size.
 - Sometimes, it just all depends on what you have on hand and, if you can adapt to it, that saves you money.
 - In addition certain drive bits (hex / torx etc.), within a kit of them, will have different drive requirements (usually 1/4" and 3/8" drive internal squares).
 - But, true tool nuts will want to have them all and still need more.
 - You can also use two adapters back to back to go from 1/2" to 3/8" and then from 3/8" to a 1/4" drive socket. There are other combinations as well.
 - If you plan on using a torque wrench, below are some basic size adapters that you'll probably want on hand.

So, go ahead and buy them just to have them. You'll appreciate them all eventually.... and

probably want more too.

- When buying a torque wrench, these are some suggested adapters to have on hand or buy with it:
 - **1/4" drive torque wrench** may be required for the lower torque bolts (primary, gearcase, derby covers, etc.) which you can buy hex (allen) and star sockets for. However, some are 1/4" and others are 3/8" drive socket ends. So, you'll need a 1/4" to 3/8" drive adapter to be able to swap back and forth with these sockets and still use the torque wrench to tighten them properly.
 - **3/8" drive torque wrench** (in some instances) may be useful for both 1/4" and 1/2" drive sockets so you'll need an adapter up and one down for versatility.
 - **1/2" drive torque wrench** will probably be too strong to use 1/4" sockets but you'll definitely want to get a 3/8" adapter in case you need to swap back and forth with 1/2" and 3/8" drive sockets.
 - **3/4" drive torque wrench** is usually only used in high torque applications and you should only need a 1/2" drive adapter in it's use.



35)



36)

Swivel or Universal Joint (off center by default)

- **A swivel, used with a torque wrench, can be detrimental to achieving even accurate torque.**
- A swivel is a great little tool for getting into areas where a straight run at a nut / bolt is hindered by obstacles near it (whether by the frame, wheels etc).
- Whether that is a concern to you or your project, you'll have to make that decision. This is just an informative on the subject.
- **The sole reason for using a swivel is to get at a bolt/nut from an angle.**
- With the entire purpose of using a torque wrench being to evenly distribute clamping force throughout the clamped piece, and the purpose of a swivel is to allow you get to angled areas of your work piece, these two tools seem to cancel each other (in theory).
- **How much the swivel will change the actual torque on a fastener depends entirely on the angle at which it is used.**
 - Any angle different than 90° from the wrench will shorten the distance from the bolt to the wrench.

- This shorter distance will decrease the amount of actual torque applied the bolt.
- You wouldn't think that the length of a socket extension between the swivel and the torque wrench would affect actual torque.

But the truth is that the longer the extension you use, the more angle you can put on the swivel which does change actual torque at the fastener.

- A swivel adapter will transmit different amounts of torque and rotation depending on where the two pins are relative to the angle.

You can see this for yourself by sticking two extensions into the adapter, bending it about 70 degrees, and slowly rotating the two extensions.

With a small angle the error is not too large but as the angle increases the errors increase. ³⁷⁾

- **With these conditions in mind, swivels have been used with torque wrenches for a very long time.**

Of course, results will vary and some will say the amount of change in actual torque value at the fastener will be negligible.

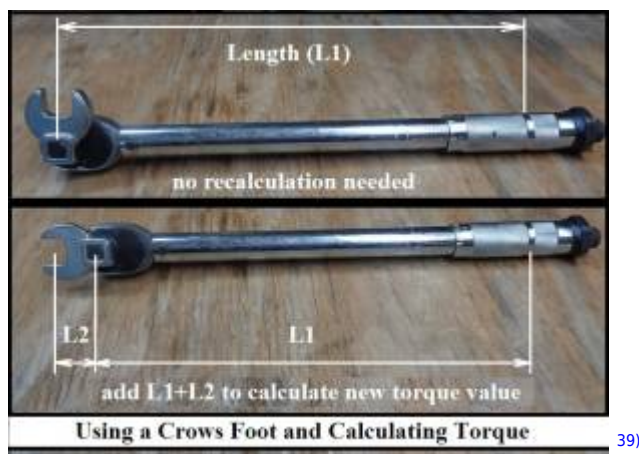
This is ultimately left up to the end user to decide what is best for them.

Crows Foot

Any force that is applied that isn't at a 90° angle will change the applied torque to the fastener. ³⁸⁾

When you put a crows foot on a torque wrench and use it long-ways, the torque applied to the fastener increases.

If you turn the crows foot at a 90° angle, there is no increase in torque to the fastener from the preset scale.



³⁹⁾

A Torque Wrench Does Not Break Bolts

See also [Common Causes of Stripped or Damaged Plug Threads](#) in the Sportsterpedia.

There is always a hand pulling that wrench.

The invent of the clicker type torque wrench took the focus away from 'feeling' what you are doing while tightening.

Try and develop a 'feel' for when enough is enough especially if using a clicker type wrench. If the wrench fails to click, and many of them do on the low end of their scale especially, you can break something simply waiting for the click.

Clamp Force

The first 5 threads of a bolt does all of the work with the first 3 doing about 80% of the holding. All other threads are just along for the ride. ⁴⁰⁾

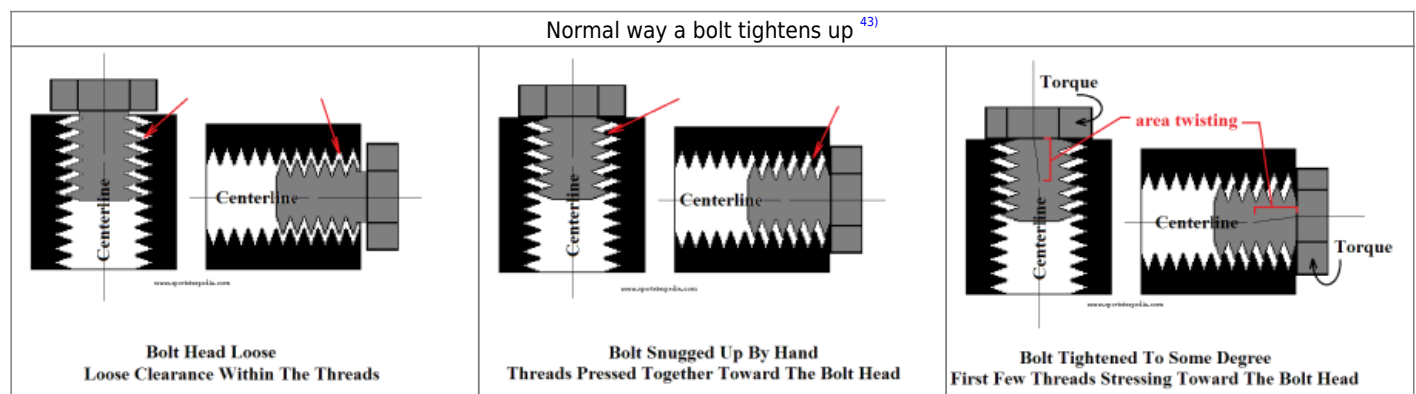
Look at the length of a standard nut. ⁴¹⁾

A bolt will hold the same clamp force if you use a nut on the end or if the bolt is sunk down into 2" of a threaded hole.

(given the nut and the hole are the same material and thread pitch)

When you tighten a bolt, the threads on the bolt and the threads in the hole will pull against each other. The bolt will deflect or stretch and this stretch is the clamping force that holds the parts together. ⁴²⁾

If you over torque the fastener, it can deform and will lock the threads together so it can not be removed. And it may break the threads in the hole, destroying them. You may not realize this until you have a leak or the next time you remove the bolt.



A Word on Torque and Re-using Bolts

- **There are many bolts on a Sportster that the MoCo writes in the FSM to discard and replace them with new ones.**
 - How many of those bolts get reused? How many of those have been tightened too much before, that now seem to be breaking?
 - Every time you tighten a bolt/screw, it stretches to some degree. It's job is to stretch back when removed.
 If stretched beyond it's intended range, it may not flex back to it's original resting position or it may be weakened from prior use.
 Then the next time it's tightened, it may not be able to be tightened to intended torque values before breaking.
- **There are times when threads are known to be warped / damaged but will be used**

anyway for different reasons.

- It is a good idea to reduce the torque used on fasteners in this instance in an effort to save the threads until a proper repair can be made.
- Thread dressings (anti-seize, Loctite etc.) may help to keep the fastener from walking out due to vibration.
- **Don't make the mistake of over-tightening just to say you are at factory torque spec.**
 - You'll have to use your own judgment for how tight is too tight.
Read more about [Using "Feel" While Tightening](#) above.
 - Sometimes (snug up to "firm plus a little more") ⁴⁴⁾ goes a long way.

One of these bolts was broken off in a rocker box. The others were damaged but not broken.

These bolts were damaged due to a clicker wrench not operating properly.

The person using the torque wrench felt it happening yet kept pulling awaiting the click.

"I did notice before it snapped that it kind of spun for a second, then broke. One of the other bolts did the same thing and I stopped immediately." ⁴⁵⁾

Any time you have any amount of thread damage or bolt stretch, replace the bolts.



Torque Range

Torque specifications are normally stated within a range and not a specific number. The range is given to accommodate these factors.

- **When the nut on a bolt is tightened;** ⁴⁷⁾
 - An initial tensile load is placed on the bolt that must be taken into account in determining it's safe working strength or external load-carrying capacity.
 - The total load on the bolt theoretically varies from a maximum equal to the sum of the initial and external loads.
(from when the bolt is absolutely rigid and the parts held together are elastic) to a minimum equal to either the initial or external loads, whichever is the greater.
(where the bolt is elastic and the parts held together are absolutely rigid).
 - No material is absolutely rigid, so in practice the total load values fall somewhere between these maximum and minimum limits.

(depending upon the relative, elasticity of the bolt and joint members)

- **So the torque range takes into account two things.**

1. The strength of the fastener.
2. The strength of the material being fastened.

- **If you change bolt type (swap a grade 8 bolt for a stainless bolt), you have effectively changed the torque range.**

- If that is a problem or not (structurally speaking) depends on the clamp load needed to fasten the piece.
- Some fasteners are intentionally used in lower strength (i.e, grade 5 on motor mounts) due to elasticity of the fastener.

Conversion Charts

Here is an [online conversion chart from Mountz](#)

Below are some conversion charts from Applifast ⁴⁸⁾

TORQUE CONVERSION FACTORS									
TO CONVERT		INTO				MULTIPLY BY			
Inch Pounds		Foot Pounds				0.0835			
Inch Pounds		Newton Meters				0.1130			
Inch Pounds		Kg Meters				0.0115			
Inch Pounds		Kg Centimeters				1.1519			
Foot Pounds		Inch Pounds				12.000			
Foot Pounds		Newton Meters				1.3560			
Foot Pounds		Kg Meters				0.1382			
Foot Pounds		Kg Centimeters				13.8240			
Newton Meters		Inch Pounds				8.8440			
Newton Meters		Foot Pounds				0.7370			
Newton Meters		Kg Meters 0.1020							
Newton Meters		Kg Centimeters				10.2000			
Kg Meters		Inch Pounds				86.8100			
Kg Meters		Foot Pounds				7.2340			
Kg Meters		Newton Meters				9.8040			
Kg Centimeters		Inch Pounds				0.8681			
Kg Centimeters		Foot Pounds				0.0723			
Kg Centimeters		Newton Meters				0.0980			
TORQUE CONVERSION - In/Lbs to (Nm)									
In/Lbs	Nm	In/Lbs	Nm	In/Lbs	Nm	In/Lbs	Nm	In/Lbs	Nm
5	0.6	30	3.4	60	6.8	110	12.4	160	18.1
10	1.1	35	4.0	70	7.9	120	13.6	170	19.2
15	1.7	40	4.5	80	9.0	130	14.7	180	20.3
20	2.3	45	5.1	90	10.2	140	15.8	190	21.5

25	2.8	50	5.7	100	11.3	150	17.0	200	22.6		
TORQUE CONVERSION - Ft/Lbs to (Nm)											
Ft\Lbs	Nm	Ft\Lbs	Nm	Ft\Lbs	Nm	Ft\Lbs	Nm	Ft\Lbs	Nm	Ft\Lbs	Nm
1	1.36	24	32.5	47	63.7	70	94.9	93	126.1	185	251.0
2	2.7	25	33.9	48	65.1	71	96.3	94	127.5	190	258.0
3	4.1	26	35.3	49	66.4	72	97.6	95	129.0	195	264.4
4	5.4	27	36.6	50	67.8	73	99.0	96	130.2	200	271.2
5	6.8	28	38.0	51	69.2	74	100.3	97	131.5	225	305.1
6	8.1	29	39.3	52	70.5	75	102.0	98	133.0	250	339.0
7	9.5	30	40.7	53	71.9	76	103.1	99	134.2	275	373.0
8	10.9	31	42.0	54	73.2	77	104.4	100	135.6	300	407.0
9	12.2	32	43.4	55	74.6	78	105.8	110	149.2	350	475.0
10	13.6	33	44.8	56	75.9	79	107.1	115	156.0	400	542.4
11	14.9	34	46.1	57	77.3	80	108.5	120	163.0		
12	16.3	35	47.5	58	78.7	81	110.0	125	170.0		
13	17.6	36	48.8	59	80.0	82	111.2	130	176.3		
14	19.0	37	50.2	60	81.4	83	112.6	135	183.1		
15	20.3	38	52.0	61	82.7	84	114.0	140	190.0		
16	21.7	39	52.9	62	84.1	85	115.3	145	197.0		
17	23.1	40	54.2	63	85.4	86	117.0	150	203.4		
18	24.4	41	55.6	64	86.8	87	118.0	155	210.2		
19	25.8	42	57.0	65	88.1	88	119.3	160	217.0		
20	27.1	43	58.3	66	90.0	89	121.0	165	224.0		
21	28.5	44	60.0	67	90.9	90	122.0	170	231.0		
22	29.8	45	61.0	68	92.2	91	123.4	175	237.3		
23	31.2	46	62.4	69	93.6	92	125.0	180	244.1		

General Torque Specs

- In lieu of having torque specs at hand, below are general torque specs for different fasteners. However, nothing takes place of manufacturer torque specs for your specific applications. The torque numbers reflect pressures the bolts can take which doesn't take into account the amount of clamp force for the piece(s) you are clamping (or an aluminum engine). So, it's hard to trust the charts that give a torque values for bolts of a certain size, and then do not specify if the bolt is going into steel or aluminum. With steel bolts going into aluminum (engines), 'ya gotta be careful.⁴⁹⁾
- Good engineering books, covering fasteners, will describe the situation in full (bolt diameter, thread pitch, bolt coatings, lubrication used etc.). A lot more information than most of us ever use. Also, in the back of some motorcycle manuals you sometimes will find charts listing common bolts and torque settings. Best to take them with a grain of salt, however.⁵⁰⁾
- In fact, there are no torque specs for the motor mount bolts in the 57-78 FSMs. And there is only value in the 79-85 FSM (rear motor mounting bolt-nut: 16 to 24 ft lbs). For the rest, there is a "General Fastener Tightening Specifications" chart in the 70-78 and 79-85

FSMs.⁵¹⁾

It lists general torque values for bolt types but not specific mounting bolts.

It also says to torque to these values given in the table unless specified otherwise.

However, these are steel to steel fasteners.

According to the chart, a 1/4" grade 8 bolt is listed as taking a torque of 14 ft/lbs.

1/4" bolts are also used on cam covers and primary covers (90-110 in/lbs (9 ft/lbs) on the 1/4" oil pump bolts)

14 ft/lbs is too much torque, not for the bolts, but for the aluminum threads in the case.

- When using oiled fasteners, you should take into account the added pre-load from the oil before applying advertised torque to avoid shearing off the bolt head or cracking/ breaking the piece your working on. You can use the Wet Chart below to calculate a torque value with the added pre-load.

Dry Torque Specs ft/lb

- Convert ft/lb to N*m by multiplying by 1.3558⁵²⁾
- Fastener strength of SAE bolts can be determined by the bolt head grade markings. Unmarked bolt heads are usually mild steel. More grade markings indicate higher strength fasteners. For instance, grade 5 may have three hash marks from the center out to the edge, grade 7 may have five hash marks and grade 8 should have 6 hash marks.⁵³⁾
- These are only generalized specs that do not take into account the difference in steel and aluminum threading. See your FSM or instruction manual for specific torque values per application.

Steel Fasteners										
Size/Grade	1/4"	5/16"	3/8"	7/16"	1/2"	9/16"	5/8"	3/4"	7/8"	1"
SAE 2	6	12	20	32	47	69	96	155	206	310 ⁵⁴⁾
SAE 5	10	19	33	54	78	114	154	257	382	587 ⁵⁵⁾
SAE 7	13	25	44	71	110	154	215	360	570	840 ⁵⁶⁾
SAE 8	14	29	47	78	119	169	230	380	600	700 ⁵⁷⁾

The following torque values (from engineersedge.com) are suggested maximums based upon actual lab testing on clean and dry or near dry fasteners.⁵⁸⁾

For other friction conditions, significant modifications may be required.

The following chart is a reprint from this site.

Torque Values for Stainless Steel and Nonferrous Fasteners (inch series)						
Bolt Size	18-8 Stainless Steel Torque in-lbs	316 Stainless Steel Torque in-lbs	Silicon Bronze Torque in-lbs	Monel Torque in-lbs	Brass Torque in-lbs	2024-T4 Aluminum Torque in-lbs
4-40	5.2	5.5	4.8	5.3	4.3	2.9
4-48	6.6	6.9	6.1	6.7	5.4	3.6
5-40	7.7	8.1	7.1	7.8	6.3	4.2
5-44	9.4	9.8	8.7	9.6	7.7	5.1

6-32	9.6	10.1	8.9	9.8	7.9	5.3
6-40	12.1	12.7	11.2	12.3	9.9	6.6
8-32	19.8	20.7	18.4	20.2	16.2	10.8
8-36	22	23	20.4	22.4	18.0	12.0
10-24	22.8	23.8	21.2	25.9	18.6	13.8
10-32	31.7	33.1	29.3	34.9	25.9	19.2
1/4-20	75.2	78.8	68.8	85.3	61.5	45.6
1/4-28	94	99	87	106	77	57
5/16-18	132	138	123	149	107	80
5/16-24	142	147	131	160	116	86
3/8-16	236	247	219	266	192	143
3/8-24	259	271	240	294	212	157
7/16-14	376	393	349	427	317	228
7/16-20	400	418	371	451	327	242
Bolt Size	18-8 Stainless Steel Torque ft-lbs	316 Stainless Steel Torque ft-lbs	Silicon Bronze Torque ft-lbs	Monel Torque ft-lbs	Brass Torque ft-lbs	2024-T4 Aluminum Torque ft-lbs
1/2-13	43	45	40	48.7	35.2	26
1/2-20	45	47	42	51	37	27
9/16-12	56	59	53	65	47	34
9/16-18	62	65	58	71	51	38
5/8-11	92	96	86	111	76	60
5/8-18	103	108	96	123	85	67
3/4-10	127	131	118	153	104	82
3/4-16	124	129	115	149	102	80
7/8-9	194	202	178	231	159	124
7/8-14	193	201	177	230	158	124
1 - 8	286	299	265	344	235	184
1 - 14	259	270	240	311	212	166

Wet Torque Value Chart for Lubed Threads From Allied Systems

If bolt threads are lubricated with light oil or anti-seize compound, the torque required to achieve the proper bolt tension is reduced. Below are charts with the proper “wet” torque values for type of bolt used: All charts property of and used by permission from Allied Systems Company.

Torque Specification Chart

The following torque values are to be used on all fasteners unless otherwise specified. Lubricated refers to fasteners in the "As Received" condition, which is normally a light preservative oil coating on unplated fasteners and no oil coating on plated fasteners. No special steps are taken to add further lubrication prior to assembly. Anti-seize refers to parts that have had an anti-seize lubricant applied just prior to assembly.

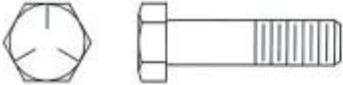
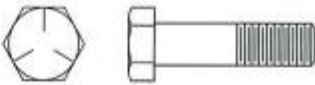


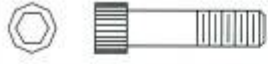
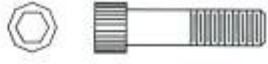
GRADE 6 COURSE THREAD

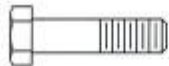
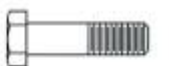
BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE	
	in-lbs	Nm	in-lbs	Nm
1/4"-20	129	15	86	10
	ft-lbs	Nm	ft-lbs	Nm
5/16"-18	23	31	15	20
3/8"-16	40	54	27	37
7/16"-14	63	85	42	57
1/2"-13	96	130	64	87
9/16"-12	140	190	93	126
5/8"-11	195	264	130	176
3/4"-10	340	461	230	312
7/8"-9	550	746	365	495
1"-8	820	1,112	550	746
1 1/8"-7	1,160	1,573	775	1,051
1 1/4"-7	1,640	2,224	1,100	1,491
1 3/8"-6	2,150	2,915	1,430	1,939
1 1/2"-6	2,850	3,864	1,900	2,576
1 3/4"-5	4,490	6,089	3,000	4,067
2"-4.5	6,750	9,152	4,500	6,101
2 1/4"-4.5	9,870	13,382	6,580	8,921
2 1/2"-4	13,500	18,304	9,000	12,202
2 3/4"-4	18,400	24,947	12,300	16,677
3"-4	24,200	32,611	16,200	21,964

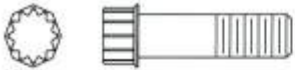
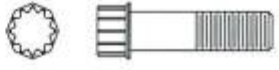
GRADE 8 FINE THREAD

BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE	
	in-lbs	Nm	in-lbs	Nm
1/4"-28	147	17	88	11
	ft-lbs	Nm	ft-lbs	Nm
5/16"-24	25	34	17	23
3/8"-24	45	61	30	41
7/16"-20	71	96	47	64
1/2"-20	108	146	72	98
9/16"-18	155	210	105	142
5/8"-18	220	298	145	197
3/4"-16	380	515	255	346
7/8"-14	605	820	405	549
1"-14	920	1,247	615	834
1 1/8"-12	1,300	1,763	870	1,180
1 1/4"-12	1,820	2,468	1,210	1,641
1 3/8"-12	2,450	3,322	1,630	2,210
1 1/2"-12	3,210	4,352	2,140	2,901

									
GRADE 5 COURSE THREAD					GRADE 5 FINE THREAD				
BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE		BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE	
	in-lbs	Nm	in-lbs	Nm		in-lbs	Nm	in-lbs	Nm
1/4"-20	91	10	61	7	1/4"-28	105	12	70	8
	ft-lbs	Nm	ft-lbs	Nm		ft-lbs	Nm	ft-lbs	Nm
5/16"-18	16	22	11	15	5/16"-24	18	24	12	16
3/8"-16	28	38	19	26	3/8"-24	32	43	21	28
7/16"-14	45	61	30	41	7/16"-20	50	68	34	46
1/2"-13	68	92	46	62	1/2"-20	77	104	51	69
9/16"-12	98	133	66	89	9/16"-18	110	149	73	99
5/8"-11	140	190	91	123	5/8"-18	155	210	105	142
3/4"-10	240	325	160	217	3/4"-16	270	366	180	244
7/8"-9	390	529	260	353	7/8"-14	430	583	285	386
1"-8	580	786	390	529	1"-14	655	888	435	590
1 1/8"-7	715	969	480	651	1 1/8"-12	805	1,091	535	725
1 1/4"-7	1,010	1,369	675	915	1 1/4"-12	1,120	1,519	745	1,010
1 3/8"-6	1,330	1,803	885	1,200	1 3/8"-12	1,510	2,047	1,010	1,369
1 1/2"-6	1,760	2,386	1,170	1,586	1 1/2"-12	1,980	2,685	1,320	1,790
1 3/4"-5	2,770	3,756	1850	2,508					
2"-4.5	4,160	5,640	2790	3,769					
2 1/4"-4.5	6,090	8,257	4060	5,505					
2 1/2"-4	8,330	11,294	5550	7,525					
2 3/4"-4	11,300	15,321	7540	10,223					
3"-4	15,000	20,337	9,940	13,477					

									
SOCKETHEAD COARSE THREAD					SOCKETHEAD FINE THREAD				
BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE		BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE	
	in-lbs	Nm	in-lbs	Nm		in-lbs	Nm	in-lbs	Nm
1/4"-20	150	17	100	11	1/4"-28	172	19	115	13
	ft-lbs	Nm	ft-lbs	Nm		ft-lbs	Nm	ft-lbs	Nm
5/16"-18	26	35	18	24	5/16"-24	29	39	20	27
3/8"-16	46	62	31	42	3/8"-24	52	71	35	47
7/16"-14	74	100	49	66	7/16"-20	82	111	55	75
1/2"-13	115	156	75	102	1/2"-20	130	176	84	114
9/16"-12	160	217	105	142	9/16"-18	175	237	120	163
5/8"-11	215	292	145	197	5/8"-18	245	332	165	224
3/4"-10	385	522	255	346	3/4"-16	425	576	285	386
7/8"-9	615	834	410	556	7/8"-14	660	922	455	617
1"-8	920	1,247	615	834	1"-14	1,035	1,403	690	936
1 1/8"-7	1,305	1,769	870	1,180	1 1/8"-12	1,465	1,986	975	1,322
1 1/4"-7	1,840	2,495	1,230	1,668	1 1/4"-12	2,040	2,766	1,360	1,844
1 3/8"-6	2,415	3,274	1,610	2,183	1 3/8"-12	2,750	3,728	1,835	2,488
1 1/2"-6	3,205	4,345	2,135	2,895	1 1/2"-12	3,605	4,868	2,405	3,261
1 3/4"-5	5,050	6,847	3,370	4,569					
2"-4.5	7,590	10,291	5,060	6,860					
2 1/4"-4.5	11,100	15,050	7,400	10,033					
2 1/2"-4	15,185	20,588	10,125	13,728					
2 3/4"-4	20,610	27,943	13,740	18,629					
3"-4	27,190	36,865	18,130	24,581					

  					  				
316 SS OR F593 G & H COURSE THREAD					316 SS OR F593 G & H FINE THREAD				
BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE		BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE	
	in-lbs	Nm	in-lbs	Nm		in-lbs	Nm	in-lbs	Nm
1/4"-20	59	7	40	5	1/4"-28	68	8	45	5
	ft-lbs	Nm	ft-lbs	Nm		ft-lbs	Nm	ft-lbs	Nm
5/16"-18	11	15	7	9	5/16"-24	12	16	8	11
3/8"-16	19	26	13	18	3/8"-24	21	28	14	19
7/16"-14	29	39	20	27	7/16"-20	33	45	22	30
1/2"-13	45	61	30	41	1/2"-20	50	68	34	46
9/16"-12	64	87	43	58	9/16"-18	71	96	48	65
5/8"-11	88	119	59	80	5/8"-18	100	136	67	91
3/4"-10	110	149	72	98	3/4"-16	125	169	81	110
7/8"-9	175	237	116	157	7/8"-14	195	264	130	176
1"-8	265	359	174	236	1"-14	295	400	200	271
1 1/8"-7	370	502	247	335	1 1/8"-12	415	563	280	380
1 1/4"-7	525	712	348	472	1 1/4"-12	580	786	385	522
1 3/8"-6	685	929	456	618	1 3/8"-12	780	1,058	520	705
1 1/2"-6	910	1,234	605	820	1 1/2"-12	1,030	1,396	685	929
1 3/4"-5	1440	1,952	954	1,293					
2"-4.5	2160	2,929	1440	1,952					
2 1/4"-4.5	3150	4,271	2100	2,847					
2 1/2"-4	4310	5,844	2870	3,891					
2 3/4"-4	5840	7,918	3900	5,288					
3"-4	7710	10,453	5140	6,969					

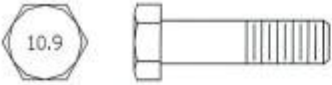
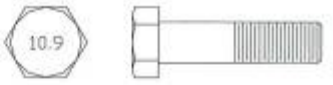
									
12 POINT FERRY HEAD COURSE THREAD					12 POINT FERRY HEAD FINE THREAD				
BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE		BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE	
	in-lbs	Nm	in-lbs	Nm		in-lbs	Nm	in-lbs	Nm
1/4"-20	150	17	100	11	1/4"-28	172	19	115	13
	ft-lbs	Nm	ft-lbs	Nm		ft-lbs	Nm	ft-lbs	Nm
5/16"-18	26	35	18	24	5/16"-24	29	39	20	27
3/8"-16	46	62	31	42	3/8"-24	52	71	35	47
7/16"-14	74	100	49	66	7/16"-20	82	111	55	75
1/2"-13	115	156	75	102	1/2"-20	130	176	84	114
9/16"-12	165	224	110	149	9/16"-18	180	244	120	163
5/8"-11	225	305	150	203	5/8"-18	255	346	170	230
3/4"-10	400	542	285	359	3/4"-16	445	603	295	400
7/8"-9	640	868	425	576	7/8"-14	705	956	470	637
1"-8	955	1,295	640	868	1"-14	1,080	1,464	715	969
1 1/8"-7	1,310	1,776	870	1,180	1 1/8"-12	1,470	1,993	980	1,329
1 1/4"-7	1,840	2,495	1,230	1,668	1 1/4"-12	2,040	2,766	1,360	1,844
1 3/8"-6	2,420	3,261	1,610	2,163	1 3/8"-12	2,750	3,728	1,840	2,495
1 1/2"-6	3,210	4,352	2,140	2,901	1 1/2"-12	3,610	4,895	2,410	3,268
1 3/4"-5	5,050	6,847	3,370	4,569					
2"-4.5	7,590	10,291	5,060	6,860					
2 1/4"-4.5	11,100	15,050	7,400	10,033					
2 1/2"-4	15,200	20,606	10,200	13,829					
2 3/4"-4	20,700	28,065	13,800	18,710					
3"-4	27,200	36,876	18,200	24,676					

ASTM A320-7 COURSE THREAD

BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE	
	in-lbs	Nm	in-lbs	Nm
1/4"-20	96	11	64	7
	ft-lbs	Nm	ft-lbs	Nm
5/16"-18	17	23	11	15
3/8"-16	30	41	20	27
7/16"-14	47	64	32	43
1/2"-13	72	98	48	65
9/16"-12	105	142	69	94
5/8"-11	145	197	95	129
3/4"-10	255	346	170	230
7/8"-9	410	556	275	373
1"-8	610	827	410	556
1 1/8"-7	865	1,173	575	780
1 1/4"-7	1,220	1,654	815	1,105
1 3/8"-6	1,600	2,169	1,070	1,451
1 1/2"-6	2,120	2,874	1,420	1,925
1 3/4"-5	3,340	4,528	2,230	3,023
2"-4.5	5,020	6,806	3,350	4,542
2 1/4"-4.5	7,340	9,952	4,900	6,644
2 1/2"-4	10,100	13,694	6,700	9,084
2 3/4"-4	13,700	18,575	9,090	12,324
3"-4	18,000	24,405	12,000	16,270

ASTM A320-7 FINE THREAD

BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE	
	in-lbs	Nm	in-lbs	Nm
1/4"-28	110	12	73	8
	ft-lbs	Nm	ft-lbs	Nm
5/16"-24	19	26	13	18
3/8"-24	34	46	23	31
7/16"-20	53	72	35	47
1/2"-20	81	110	54	73
9/16"-18	115	156	77	104
5/8"-18	165	224	110	149
3/4"-18	285	386	190	258
7/8"-14	450	610	300	407
1"-14	685	929	460	624
1 1/8"-12	970	1,315	645	875
1 1/4"-12	1,350	1,830	900	1,220
1 3/8"-12	1,820	2,468	1,220	1,654
1 1/2"-12	2,390	3,240	1,590	2,156

									
METRIC GRADE 10.9 COARSE THREAD					METRIC GRADE 10.9 FINE THREAD				
BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE		BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE	
	in-lbs	Nm	in-lbs	Nm		in-lbs	Nm	in-lbs	Nm
6-1.00	119	13	80	9	6-0.75	131	15	87	10
	ft-lbs	Nm	ft-lbs	Nm		ft-lbs	Nm	ft-lbs	Nm
8-1.25	25	34	17	23	8-1.00	26	35	18	24
10-1.50	48	65	32	43	10-1.25	51	69	34	46
12-1.75	84	114	56	76	12-1.50	88	119	59	80
14-2.00	135	183	89	121	14-1.50	145	197	96	130
16-2.00	210	285	140	190	16-1.50	225	305	150	203
20-2.50	405	549	270	366	18-1.50	360	486	240	325
22-2.50	550	746	370	502	20-1.50	495	671	330	447
24-3.00	700	949	465	630	22-1.50	660	895	440	597
27-3.00	1,030	1,396	685	929	24-2.00	860	1,166	575	780
30-3.50	1,390	1,885	925	1,254	27-2.00	1,230	1,668	820	1,112
36-4.00	2,430	3,295	1,620	2,196	30-1.50	1,850	2,506	1,230	1,668
42-4.50	3,880	5,261	2,590	3,512					
48-5.00	5,630	7,904	3,890	5,274					
56-5.50	9,370	12,704	6,250	8,474					
64-6.00	14,200	19,253	9,410	12,758					
72-6.00	20,600	27,930	13,700	18,575					
80-6.00	28,700	38,912	19,100	25,896					
90-6.00	41,500	56,266	27,700	37,556					
100-6.00	57,700	78,231	38,500	52,199					

METRIC GRADE 12.9 SOCKET HEAD COARSE THREAD

BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE	
	in-lbs	Nm	in-lbs	Nm
6-1.00	135	15	90	10
	ft-lbs	Nm	ft-lbs	Nm
8-1.25	28	38	19	26
10-1.50	54	73	36	49
12-1.75	95	129	63	85
14-2.00	155	210	105	142
16-2.00	235	319	160	217
20-2.50	460	624	305	414
22-2.50	625	847	415	563
24-3.00	790	1,071	525	712
27-3.00	1,160	1,573	770	1,044
30-3.50	1,570	2,129	1,050	1,424
36-4.00	2,740	3,715	1,830	2,481
42-4.50	4,390	5,952	2,930	3,973
48-5.00	6,590	8,935	4,390	5,952
56-5.50	10,600	14,372	7,060	9,572
64-6.00	16,000	21,693	10,700	14,507
72-6.00	23,200	31,455	15,500	21,015
80-6.00	32,400	43,928	21,600	29,286
90-6.00	46,900	63,588	31,300	42,437
100-6.00	65,200	88,399	43,500	58,978

METRIC GRADE 12.9 SOCKET HEAD FINE THREAD

BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE	
	in-lbs	Nm	in-lbs	Nm
6-0.75	148	17	98	11
	ft-lbs	Nm	ft-lbs	Nm
8-1.00	30	41	20	27
10-1.25	57	77	38	52
12-1.50	99	134	66	89
14-1.50	165	224	110	149
16-1.50	250	339	170	230
18-1.50	405	549	270	366
20-1.50	560	759	375	506
22-1.50	745	1,010	500	678
24-2.00	970	1,315	645	875
27-2.00	1,390	1,885	925	1,254
30-1.50	2,090	2,834	1,390	1,885

METRIC 316 OR 304 SS COARSE THREAD				
BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE	
	in-lbs	Nm	in-lbs	Nm
6-1.00	55	6	37	4
	ft-lbs	Nm	ft-lbs	Nm
8-1.25	12	16	8	11
10-1.50	23	31	15	20
12-1.75	39	53	26	35
14-2.00	62	84	41	56
16-2.00	96	130	64	87
20-2.50	190	258	125	169
22-2.50	255	346	170	230
24-3.00	325	441	215	292
27-3.00	475	644	315	427
30-3.50	640	868	430	583
36-4.00	1,120	1,519	750	1,017
42-4.50	1,800	2,440	1,195	1,620
48-5.00	2,700	3,661	1,800	2,440
56-5.50	4,330	5,871	2,890	3,918
64-6.00	6,520	8,840	4,350	5,896
72-6.00	9,480	12,853	6,320	8,569
80-6.00	13,300	18,032	8,820	11,958
90-6.00	19,200	26,032	12,770	17,314
100-6.00	26,700	36,200	17,800	24,134

METRIC 316 OR 304 SS FINE THREAD				
BOLT size-pitch	LUBRICATED		WITH ANTI-SEIZE	
	in-lbs	Nm	in-lbs	Nm
6-0.75	60	7	40	5
	ft-lbs	Nm	ft-lbs	Nm
8-1.00	12	16	8	11
10-1.25	24	33	16	22
12-1.50	41	56	27	37
14-1.50	67	91	45	61
16-1.50	102	138	68	92
18-1.50	165	224	110	149
20-1.50	230	312	155	210
22-1.50	305	414	205	278
24-2.00	395	536	265	359
27-2.00	570	773	380	515
30-1.50	855	1,159	570	773

9

Wet/Dry Charts from Applifast

INCH BOLT TORQUE TABLE (SAE J429 and ASME 574)							METRIC BOLT TORQUE TABLE (ISO 898)						
Steel Grade	SAE 5		SAE 8		Socket Head Cap Screw		Property Class	8.8		10.9		12.9 Socket Head Cap Screw	
Nom Dia-Pitch	Torque in ft/lbs or (in/lbs)						Nom Size x Pitch	Torque in Newton Meter - Nm					
	Dry	Lubed	Dry	Lubed	Dry	Lubed		Dry	Lubed	Dry	Lubed	Dry	Lubed
1/4-20	(101)	(76)	(143)	(107)	(168)	(120)	M5 x 0.80	6.1	4.6	8.8	6.7	10.3	7.7
1/4-28	(116)	(87)	(147)	(123)	(192)	(144)	M6 x 1.00	10.4	7.8	15	11.2	17.6	13.1
5/16-18	(209)	(157)	(295)	(221)	(348)	(264)	M7 x 1.00	17.6	13.1	25.1	18.9	29.4	22
5/16-24	(231)	(174)	(327)	(245)	(384)	(288)	M8 x 1.25	25.4	19.1	37.6	27.3	42.6	32.1
3/8-16	(372)	(276)	44	33	51	38	M10 x 1.50	50	38	72	54	84	64

3/8-24	(420)	(312)	49	37	58	43	M12 x 1.75	88	66	126	94	146	110
7/16-14	49	37	70	52	81	61	M14 x 2.00	141	106	201	150	235	176
7/16-20	55	41	78	58	91	68	M16 x 2.00	218	164	312	233	365	274
1/2-13	75	57	106	80	124	93	M18 x 2.50	301	226	431	323	504	378
1/2-20	85	64	120	90	140	105	M20 x 2.50	426	319	609	457	712	534
5/8-11	150	113	212	159	238	179	M22 x 2.50	580	435	831	624	971	728
5/8-18	170	127	240	180	27	202	M24 x 3.00	736	552	1052	789	1231	923
3/4-10	267	200	376	282	423	317	M27 x 3.00	1079	809	1544	1158	1805	1353
3/4-16	297	223	420	315	472	354	M30 x 3.50	1463	1097	2092	1570	2446	1834
7/8-9	429	322	606	455	682	511	M33 x 3.50	1990	1493	2849	2137	3328	2497
7/8-14	474	355	69	502	752	564	M36 x 4.00	2557	1918	3659	2744	4276	3208
1-8	644	483	909	681	1022	767							
1-12	722	542	1020	765	1147	860							

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2)

<https://study.com/academy/lesson/what-is-torque-definition-equation-calculation.html>

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4)

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43)

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44)

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45)

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