CDI TORQUE PRODUCTS

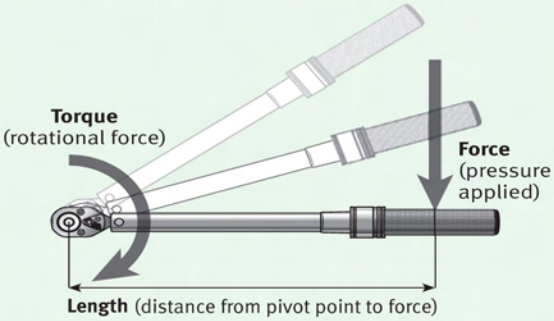
TORQUE WRENCH 101

END-USER EDITION

WHAT IS TORQUE?

Torque is rotational or ***turning force***

Torque is measured in length and force:
Length means distance from "center of drive" to "center of handle"
Force means "pounds", "Newtons" etc



Length × Force = TORQUE

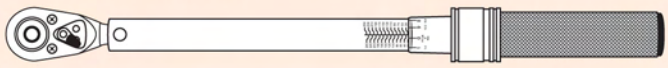
The standard torque formula used to calculate torque is "Length x Force = Torque" (L x F = T)

Example A: 2 ft. (length as shown above) x 30 lbs. (amount of force at center of handle) = 60 ft. lbs. of torque (60 Ft. Lbs.)

Example B: 1 meter x 25 Newtons = 25 Newton Meters (25 Nm)

WHAT IS A TORQUE WRENCH?

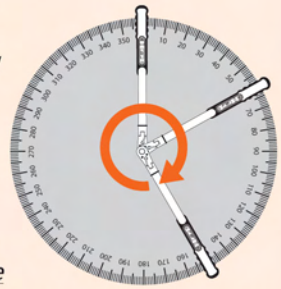
- A torque wrench is any device that applies a pre-determined amount of torque to a fastener.
- It may be mechanical or electronic in design.
- A torque wrench has some type of indicating device which lets the operator know when the correct torque has been achieved: "click" or "impulse-break" feel; sound; lights; gauge; or some combination of these.



QUICK FACT: The Micrometer Click Type Wrench (Shown) is the most affordable and common torque wrench used today.

TORQUE & ANGLE

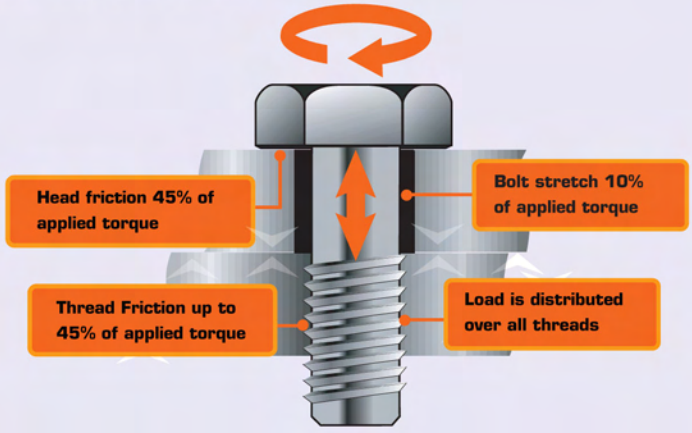
Auto manufacturers and makers of other high performance equipment are increasingly specifying fasteners with a combination of torque value followed by additional tightening with "angle", or degrees of wrench turn. Manufacturers can calculate a more exact final "clamp load" for their applications, since "torque & angle" minimizes the impact of thread or under-head friction *(see* "What Does Torque Do" illustration and last bullet below). *Note: The CDI "Torque & Angle" electronic wrenches easily handle these applications.*



Example: Apply 80 ft. lbs. of torque, then apply 90 degrees of rotation

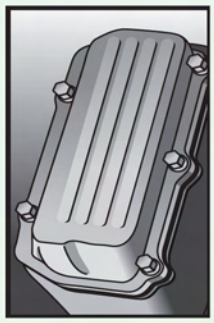
WHAT DOES TORQUE DO?

- Bolts (or threaded fasteners), are designed to create clamping force, also called "clamp load".
- When torque is applied to a threaded fastener, it draws together the joint, (two pieces of material).
- As additional torque is applied to the fastener, the joint is pulled together creating a clamp load as the fastener begins the stretching process. It's this fastener stretch that creates and maintains clamping force, like a stretched bungee cord maintaining tension.
- The actual amount of clamp load is determined by several factors:
  - The amount of torque applied to the fastener.
  - The material and grade of the fastener.
  - The external friction on the joint – friction under the fastener head, and friction between the threads of the fastener and material it's connected to.



WHY IS APPLYING PROPER TORQUE IMPORTANT?

- *Safety & Performance:* Applying accurate torque is critical to assembly applications, engines and precision equipment.
- Creating a proper clamp load is the main objective when applying torque to a fastener. Engine cylinder heads, pipe coupling, wheels, all need to be "clamped" uniformly to specific torque values.
- There are three main factors that affect the correct application of torque: (1) Condition of components, (2) Accuracy of torque instrument, (3) Properly applied torque values.
- Applying torque incorrectly can lead to stripped threads, premature loosening or broken fasteners that can cause catastrophic failure. Leaking joints may cause engine or equipment failures.



TORQUE DEFINITIONS

A.S.M.E. – American Society of Mechanical Engineers, known for setting codes and standards for mechanical devices, including torque.

CW – Clockwise. Used in all accuracy statements & Certs. Some tools have different accuracy depending on direction of use.

CCW – Counter Clockwise

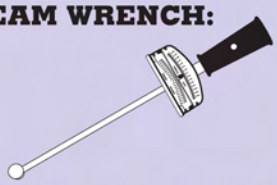
Calibration – Adjusting a torque tool or a torque transducer in order to bring it back within spec, which is performed on a calibration system such as the CDI 2800-1 or 2000-1. Typical calibration accuracy is ± 4% CW of indicated value.

Certification – Also called a "Cert", this is a form which lists the results of the calibration test. Almost all CDI tools are supplied with a N.I.S.T. traceable cert. CDI also conforms to the ISO 6789, which is the standard set forth by the International Organization for Standardization (ISO) for torque measurement.

Cycling – For mechanical torque wrenches, to "exercise" the wrench for use. With a new wrench, and for first use of the day, set the wrench at the desired torque value and pull for several

TYPES OF TORQUE WRENCHES

BEAM WRENCH:



The beam wrench, invented in the early 1900's, is a very simple design, not easy to read, and not considered a precise torque tool for today's standards of accuracy. CDI does not offer this type of wrench.

	MICROMETER	SPLIT BEAM	MECHANICAL DIAL
			
DESCRIPTION	Also referred to as a "Click" wrench, these are the most popular type of mechanical torque wrench. An internal spring is tightened by turning the handle. The spring pushes against a block, and both are calibrated so the block pivots when the torque setting has been reached. This quick pivoting creates the "click" sound. When the force at the handle is released, the block resets to it's original position and is ready for the next torque application.	Also called a "Quick Adjust" wrench, this type is most popular for automotive tire and wheel installation and other heavy use environments. Torque value is set by turning a small knob on the side of the wrench. Two internal arms (the "split beam") bend when force is applied at the handle, and a trigger device reacts when the set torque is reached, causing a "click" that can be felt and heard.	Uses a fixed, non-ratcheting square drive. Available in single scale and dual scale models. As force is applied at the handle, an internal beam flexes against a precision movement which rotates a needle pointing to the torque value against the dial scale. A memory needle indicates the highest torque value achieved.
OPERATION	Set the desired torque value by pulling down on the lock ring while turning the handle. Always approach torque setting from a lower setting. The tube displays the major torque values, and the lock ring has the minor torque values. Apply force at the handle until the "click" is felt or heard, and then release force.	Set the desired torque value by turning the knob on the side of the wrench. Always approach torque setting from a lower setting. Apply force at the handle until the "click" is felt or heard, and then release force.	Reset the orange pointer to zero by grasping the black bezel ring and turning. Turn the blue needle until it contacts, but does not move, the main orange pointer needle. Pull to desired torque and release. Needle must NEVER exceed 180 degrees of movement.
ADVANTAGES	Most common type of torque wrench. "Click" felt at the handle indicates torque value reached. Rugged, durable legacy design.	Fast to set; no unwinding after use. "Click" felt in handle indicates torque value. One way ratchet eliminates damage due to misuse as a breaker bar.	Very accurate, user can visually track the approaching and achieved torque value on scale. Also you can observe the "effect" of torque on the work piece.
DISADVANTAGES	After day's use, internal spring pressure must be released by unwinding the handle.	One way ratchet does not allow counterclockwise torque (this is a very rare need). Less fine adjustment vs. micrometer.	Fixed (non-ratcheting) head. Subject to viewing angle (parallax) error.
APPLICATIONS	Highly versatile: any general purpose torque applications: auto engine, machine maintenance, construction, oil field, compressor/generator, etc.	Brake, tire and wheel shops; any general purpose mechanical applications.	Wherever the "effect" of torque needs to be observed. Recommended for use with all torque multipliers. Lower cost substitute for electronic wrenches when high accuracy is required.

clicks on a stationary fastener. This exercises the internal wrench mechanism and ensures smooth and accurate operation.

ISO 17025 – A laboratory accreditation standard. Most all torque wrenches (including CDI) do not come with ISO 17025 accredited certifications. But torque wrenches can receive accredited certification for an additional fee (range of $50-200 depending on tool) if the end-user desires.

N.I.S.T. – National Institute of Standards and Technology is a non-regulatory agency of the US Department of Commerce. They are the federal agency that sets standards for all weights and measures in the U.S. All CDI torque products are calibrated on testers calibrated with weights and arms that are all traceable back to N.I.S.T.

Newton – A Newton is a common unit of weight used for torque from the SI system (not metric). Equivalent to 102 grams / .273 pounds.

Rolling Torque – Measuring the prevailing torque, or resistance, of a rotating shaft.

Strain Gage – A strain gage is an electronic device used to measure the bend or turn resistance of an object. The measured strain is then translated into torque.

Testing – To determine the accuracy of the tool. It does not include adjusting the tool. Commonly called "as found" data.

Torque plus Angle (T & A) – Tightening the fastener to a specific torque, then further turning a specific number of degrees (angle) of rotation. Example: 70 ft. lbs. + 40 degrees.

Torque to Yield (TTY) – Same method as torque plus angle except utilizes "single use" or "TTY" fasteners. These are special one-time-use fasteners which are stretched into their yield zone and cannot be used again.

DIGITAL DIAL

More accurate than a mechanical dial, and easier to use and read because of large LCD readout and color LED light bar. Utilizes an internal electronic strain gage to measure torque. Uses a fixed, non-ratcheting square drive as do the mechanical dial wrenches

Turn on using the power button, set the units of torque by pressing the "U" button, and set the desired torque using the "+ or -" keys. Pull wrench, slow down when YELLOW LED lights, and stop when GREEN lights.

Highly accurate. Easy read LCD, and LED lights indicate approaching (yellow), achieved (green), and over torque (red). Peak hold mode measures breakaway torque. Also measures rolling torque.

Fixed (non-ratcheting) head

Great for use in any dial wrench application where more accuracy is required. Checks rolling torque; auditing breakaway (removal) torque. Easy to use low cost digital torque wrench.

ELECTRONIC

Most versatile and accurate torque wrench. Operates by means of a internal electronic strain gage with digital readout. Torque value setting can be heard (beep) and seen (digital screen and lights). Torque & Angle models enable fast and easy application of desired torque, plus additional angle application through internal Gyro chip which measures up to 360 degrees of rotation.

Turn on using the power button, set the units of torque by pressing the "U" button, and set the desired torque using the "+ or -" keys. Pull wrench, slow down when YELLOW LED lights, and stop when GREEN lights.

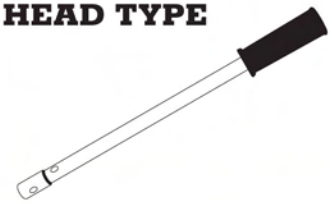
Highly accurate; easy to use; at least 3 units of measure (ft. lbs., in. lbs., Nm); some models measure angle. Faster for most applications. Peak hold mode measures breakaway torque.

More susceptible to damage if exposed to moisture.

May be used virtually anywhere a click wrench is used. Anyone using a click wrench should experience the advantages and benefits of a Electronic torque wrench.

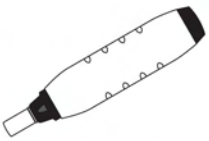
OTHER TORQUE TOOLS

INTERCHANGEABLE HEAD TYPE



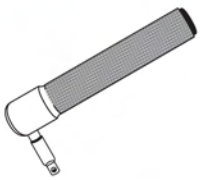
Allows various head designs and sizes to be used in the same wrench body. Available in preset, single setting design or adjustable type.

SCREWDRIVERS



Used for applying torque in low torque applications, such as electronic assembly manufacturing, medical devices, etc. Available in adjustable models, or factory preset to a single torque value. Ergonomic tri-lobe handle design.

TORKYS

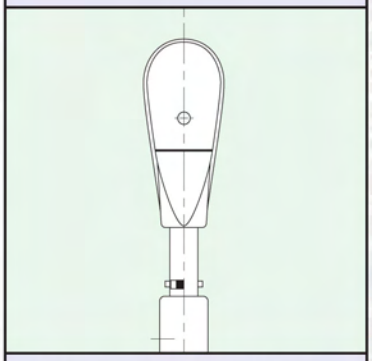


Used in higher torque applications than torque screwdrivers (can be factory preset to a single torque value from 30 to 170 in. lbs.). Features "L" shaped handle design enabling easier leverage for higher torque values. Commonly used for carbide tipped milling cutters, and many other applications where space is limited

WRENCH HEADS

Interchangeable Heads: Accepts "J", "Y", "X", or "Z" interchangeable heads. Receiver on handle assembly must be the same as the head. IE: "Y" shank tools only work with "Y" shank heads.

Shank sizes:
"J"=.425"
"Y"=.560"
"X"=.735"
"Z"=.990"



The new dual pin (DP) heads ONLY fit DP handles.

QUICK FACT:

The first Torque Wrench was invented by Conrad Bahr in 1918 while working for the New York City Water Department. It was designed to prevent overtightening bolts on water main and steam pipe repairs underground.

Source: Wikipedia

CDI TORQUE WRENCH RANGE AVAILABILITY

Note: Ranges covered may require more than one wrench model.

		1/4"	3/8"	1/2"	3/4"	1"
MICROMETER ADJUSTABLE (Dual Scale)	In. Lb. / Nm	10-150 / 1.4-15.3	20-1000 /2.8-110.2	300-2500 / 39.6-276.9		
	Ft. Lb. / Nm		5-100 / 10.2-132.2	20-250 / 34-332	50-600 / 119-779	200-1000 / 305-1322
MICROMETER COMFORT GRIP (Dual Scale)	In. Lb. / Nm	20-150 / 2.8-15.3	30-1000 /4.0-110.2			
	Ft. Lb. / Nm		10-100 /16.9-132.2	20-250 / 34-332	100-600 / 169-779	
MICROMETER ADJUSTABLE (Single Scale)	Ft. Lb.					300-2000
	Nm		10-100	40-340	150-800	300-1500
DIAL WRENCH (Single Scale) * Electronic Signaling Model Range	In. Lb.	0-75	0-600			
	Ft. Lb.		0-50	0-250	0-600	0-1000
					0-600*	0-2000*
	Nm	0-9	0-70	0-350	0-800	0-1400
DIAL WRENCH (Dual Scale) * Electronic Signaling Model Range	In. Lb. / Nm	0-75 / .5-9	0-600 / 0-70			
	Ft. Lb. / Nm		0-50 / 0-70	0-250 / 0-350	0-600 / 0-800	0-1000 / 0-1400
					0-600 / 0-800*	0-2000 / 0-2800*
SPLIT BEAM	In. Lb.		120-600			
	Ft. Lb.		20-100	40-250	80-600	
COMPUTORQ II (Electronic)	In. Lb.	5-50	25-600	300-3000	720-7200	
	Ft. Lb.	.4-4.2	2-50	25-250	60-600	100-1000
	dNm	5.6-56	28-677	340-3380	810-8130	
	Nm	.56-5.6	2.8-67.7	34-338	81-813	135-1355
	cmkg	5.7-57	29-691	340-3400	830-8300	
	mkg	.057-.57	.29-6.9	3.4-34	8.3-83	14-138
COMPUTORQ 3 (Electronic)	In. Lb.	24-240	120-1200	300-3000		
	Ft. Lb.	2-20	10-100	25-250		
	Nm	2.71-27.10	13.6-135.6	33.8-338		
	cmkg	27.6-276	138-1382	345-3456		
TORQUE & ANGLE (Electronic)	In. Lb.		120-1200	300-3000	1440-7200	
	Ft. Lb.		10-100	25-250	120-600	
	Nm		12.6-135.6	33.8-338	156-780	
DIAL (Electronic)	In. Lb.	5-50	25-600			
	Ft. Lb.	.42-4.17	2.08-50			
	Nm	.56-5.65	2.82-67.79			
	cmkg	5.7-57.61	28-691.27			

		J SHANK	Y SHANK	X SHANK	Z SHANK
INTERCHANGEABLE HEAD (Single & Dual Scale)	Ft. Lb.	5-75	20-250		
	Nm / Ft. Lb.	10-100 / 7.4-73.8	40-200 /29.5-147.5	70-350 / 44.3-250.8	150-800 / 110.6-590
SINGLE SETTING TORQUE	In. Lb. / Nm	10-300 / 1.1-34			
	Ft. Lb./ Nm	15-75 / 20-102	30-200 /41-271	100-300 /135-406	120-600 / 162-814

PROPER WRENCH SELECTION

Proper wrench selection is just as important as the wrench itself.

- The more critical the torque requirement, the more accurate (think electronic) the wrench should be.
- Choose a torque wrench that has roughly twice the capacity of the torque being applied. For example, for an application of 100 ft.lbs., choose a 200 ft.lbs. wrench. If a 200 ft.lb. wrench is not available, then a 250 ft.lb. would work as well. The "sweet spot" of a torque wrench is between 40% and 80% of the maximum scale (for a 250 ft. lb. wrench, between 100 and 200 ft. lbs).
- Avoid choosing a wrench that will be used at the bottom of the scale and also at the top of the scale. Mechanical torque wrenches are typically calibrated from 20% to 100% of full scale.

TORQUE WRENCH CARE

- Always wind down Micrometer wrenches to lowest setting for storage
- Wipe clean with soft cloth
- Store in its case with desiccant pack and manual
- Keep in a cool, dry place

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