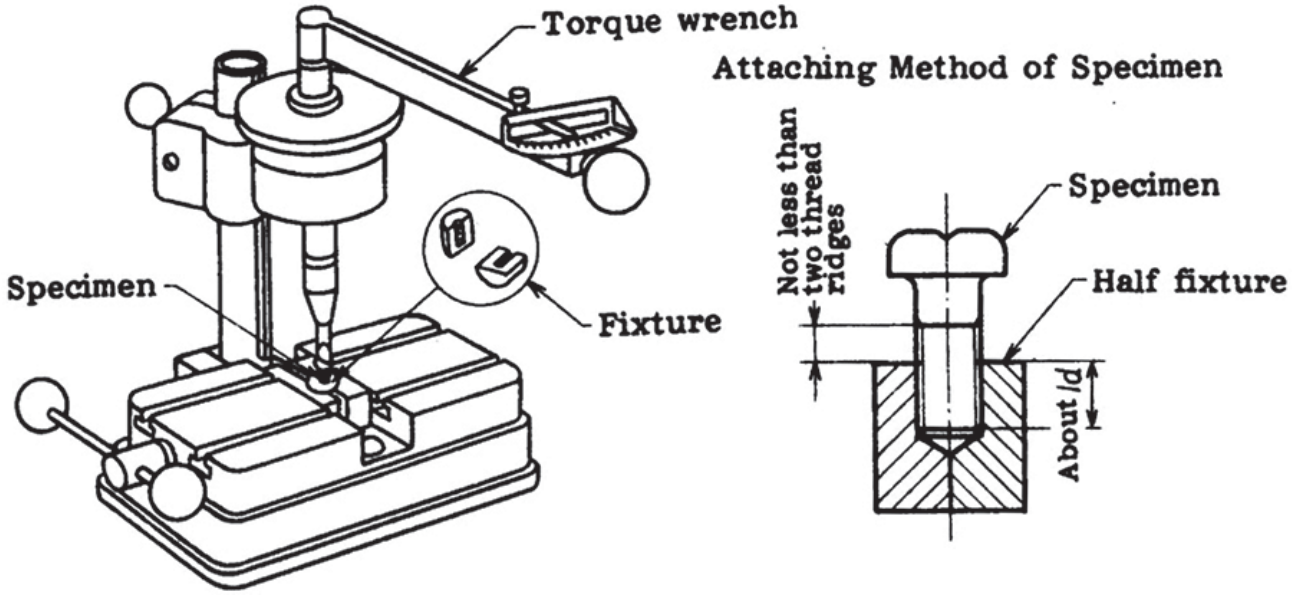
Larry Borowski President

GREENSLADE & COMPANY INC.

2234 Wenneca Avenue, Fort Worth, TX 76102
TEL 817-870-8888 FAX 817-870-9199
EMAIL sales1@greensladeandcompany.com WEB www.greensladeandcompany.com

TORSIONAL STRENGTH TEST IS CRITICAL IN MANY SCREW SPECIFICATIONS



Mechanical fasteners (screws, bolts, nuts, rivet, etc.) must be both dimensionally and physically compliant to their applicable specifications to perform properly for end-users. Unfortunately, many fastener suppliers only evaluate the dimensional size of the parts they supply and ignore the required physical tests that evaluate the strength and fastening performance of the parts.

The torsional strength test is one of the most widely specified physical tests in screw specifications. The torsional strength test determines if a screw has adequate strength to perform its intended function when put into final use. In most screw specifications in which the torsional strength test is required the parts are not required to be tested for tensile strength. The torsional strength of a screw determines its ability to resist being twisted into two pieces where as the tensile test determines a screw or bolt's ability to resist being pulled from end-to-end into two pieces.

The charts in this article list the torsional strength values specified in the following screw standards and specifications:

- ASME B18.6.3
- SAE J78
- SAE J81
- SAE J933
- SAE J1237
- ISO 2702
- ISO 3506-1
- ISO 898-7
- JIS B 1125
- DIN 7504

Torsional Strength Requirements Table 1.

Size		ASME B18.6.3	SAE J 78	SAE J81	SAE J933	ISO 2702	JIS B 1055	JIS B 1125 (steel)		JIS B 1125 (stainless steel)		DIN 7504	Size	
								Cone Point	Drill Point	Cone Point	Drill Point			
inch	metric	in.lb.	in.lb.	in.lb.	in.lb.	Nm	Nm	Nm	Nm	Nm	Nm	Nm	inch	metric
2-32	ST2.2	4			4	0.45	0.45						2-32	ST2.2
2-56		5		6	5								2-56	
2-64		6			6								2-64	
3-28	ST2.6	9			9	0.9	0.9						3-28	ST2.6
3-48		9		10	9								3-48	
3-56		10			10								3-56	
4-24	ST2.9	13	14		13	1.5	1.5	1.3	1.5	0.6	0.7	1.5	4-24	ST2.9
4-40		13	14	14	13								4-40	
4-48		15			15								4-48	
5-20	ST3.3	18			18	2.0	2.0						5-20	ST3.3
5-40		18			18								5-40	
5-44		20			20								5-44	
6-18		24			24								6-18	
6-20	ST3.5	24	24		24	2.7	2.7	2.2	2.7	1	1.2	2.8	6-20	ST3.5
6-32		23	24	22	23								6-32	
6-40		27			27								6-40	
7-16		30			30								7-16	
7-19	ST3.9	30			30	3.4	3.4	3	3.4	1.4	1.7	3.4	7-19	ST3.9
8-15		39			39								8-15	
8-18	ST4.2	39	42		39	4.4	4.4	3.7	4.4	1.7	2.0	4.5	8-18	ST4.2
8-32		42	48	24	42								8-32	
8-36		47			47								8-36	
10-12		48			48								10-12	
10-16	ST4.8	56	61		56	6.3	6.3	5.8	6.3	2.7	3.1	6.5	10-16	ST4.8
10-24		56	65	48	56								10-24	
10-32		74			74								10-32	
12-11		83			83								12-11	
12-14	ST5.5	88	92		88	10.0	10.0		10.0		5.0	10	12-14	ST5.5
12-24		93	100	65	93								12-24	
12-28		108			108								12-28	
14-10		125			125								14-10	
1/4-14	ST6.3	142	150		142	13.6	13.6		13.6		8.1	14	1/4-14	ST6.3
1/4-20		140	156	156	140								1/4-20	
1/4-28		179			179								1/4-28	
5/16-12	ST8	290			290	30.5	30.5						5/16-12	ST8
5/16-18		306		330	306								5/16-18	
5/16-24		370			370								5/16-24	
3/8-12		590			590								3/8-12	
3/8-16		560		600	560								3/8-16	
3/8-24		710			710								3/8-24	
7/16-14		700		840									7/16-14	
7/16-20		820											7/16-20	
1/2-13		1075		1080									1/2-13	
1/2-20		1285											1/2-20	

Converstions: 1 inch-pound (in.lb.) = 0.113 Newton meters (Nm); 1 Newton meter (Nm) = 8.85 inch-pounds (in.lb.)

Torsional Strength Requirements Table 2.

Size	SAE J1237	ISO 3506-1			ISO 898-7				JIS B 1054			DIN 7500-1	DIN 7513	DIN 7516	Size
	Type 2	Class 50	Class 70	Class 80	Class 8.8	Class 9.8	Class 10.9	Class 12.9	Class 50	Class 70	Class 80				
mm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	mm
M1 X 0.25					0.033	0.036	0.040	0.045							M1 X 0.25
M1.2 X 0.25					0.075	0.082	0.092	0.100							M1.2 X 0.25
M1.4 X 0.3					0.12	0.13	0.14	0.16							M1.4 X 0.3
M1.6 X 0.35		0.15	0.2	0.24	0.16	0.18	0.20	0.22	0.15	0.2	0.27				M1.6 X 0.35
M2 X 0.4	0.7	0.3	0.4	0.48	0.37	0.4	0.45	0.50	0.3	0.4	0.56	0.5			M2 X 0.4
M2.5 X 0.45	1.2	0.6	0.9	0.96	0.82	0.9	1.00	1.10	0.6	0.9	1.2	1.0	1.0		M2.5 X 0.45
M3 X 0.5	2.2	1.1	1.6	1.8	1.5	1.7	1.9	2.1	1.1	1.6	2.1	1.5	1.5	1.5	M3 X 0.5
M3.5 X 0.6	3.5				2.4	2.7	3.0	3.3				2.3			M3.5 X 0.6
M4 X 0.7	5.2	2.7	3.8	4.3	3.6	3.9	4.4	4.9	2.7	3.8	4.9	3.4	3.4	3.4	M4 X 0.7
M5 X 0.8	10.5	5.5	7.8	8.8	7.6	8.3	9.3	10.0	5.5	7.8	10	7.1	7.1	7.1	M5 X 0.8
M6 X 1.0	17.7	9.3	13	15	13	14	16	17				12	12	12	M6 X 1.0
M7 X 1.0					23	25	28	31							M7 X 1.0
M8 X 1.25	43.0	23	32	37	33	36	40	44				29	28	28	M8 X 1.25
M8 X 1.0					38	42	46	52							M8 X 1.0
M10 X 1.5	87.0	46	65	74	66	72	81	90				59			M10 X 1.5
M10 X 1.0					84	92	102	114							M10 X 1.0
M10 X 1.25					75	82	91	102							M10 X 1.25
M12 X 1.75	152.0	80	110	130											M12 X 1.75
M16 X 2.0		210	290	330											M16 X 2.0

Converstions: 1 inch-pound (in.lb.) = 0.113 Newton meters (Nm); 1 Newton meter (Nm) = 8.85 inch-pounds (in.lb.)

Fortunately, for screw suppliers there is agreement among the various screw standards and specifications regarding the torsional strength testing apparatus and the torsional strength testing procedure. The typical torsional strength testing apparatus illustration is show in this article.

Torsional Strength Test Apparatus

[1] The purpose of the torsional strength testing fixture is to enable the operator to establish and maintain full engagement of the screw driving tool with the screw's driving feature throughout the torsional strength test.

The upper arm of the fixture can be adjusted up and down its main shaft to accommodate the testing of screws having various lengths. On the end of the upper arm opposite the fixture's main shaft is the fixture's rotating shaft through which the torsional testing force is applied to the screw. The lower end of this shaft generally has a male square drive to which the screw driving tools are affixed for screw testing.

The lower base of the fixture provides a groove directly below the upper arm for clamping the split collets that hold the screw's threaded area while the torsional test is performed.

[2] The threaded split collets for holding the screw come in two styles. One style for testing screws smaller than ¼" or 6 mm in diameter are generally small and are placed into a split collet holder which fits into the groove in the base of the test fixture. The collets for screws ¼" or 6 mm and larger generally are bigger and fit directly into the groove in the fixture's base without need for the collet holder.

It is critical that screws be gripped in these threaded split collects to prevent the threads from being crushed or cut by the clamping action which keep the screws from rotating while being tested. If the threads are crushed or cut when clamped, as is the case when screws are clamped in a vise, the screw's torsional values are frequently lower than when the parts are held properly in the threaded split collets.

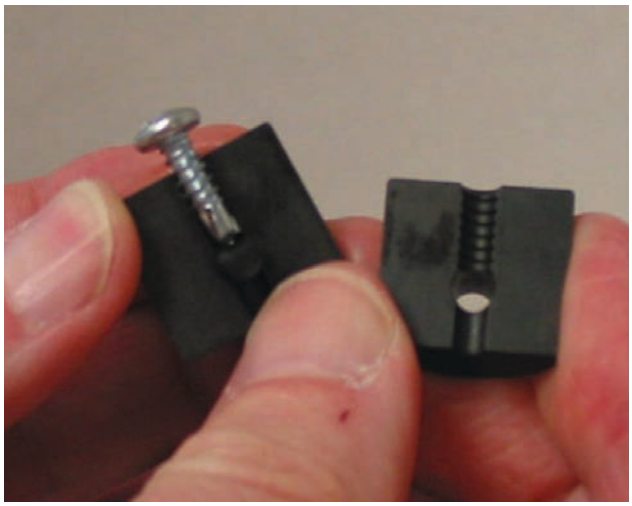
[3] A calibrated torque wrench is engaged in the fixture's rotating center shaft on top of the fixture for measuring the amount of torque required to twist the test screw into two pieces. Torque wrenches come in many styles and types, both analog and digital. The only critical features of the torque wrench used to perform the torsional strength test is that it must be calibrated and it should have a "memory needle" mechanism of some type that indicates the highest torque value occurring during each test.

The torque wrench calibration requirements vary slightly among the standards and specifications, but the most common requirement is for the wrench to be accurate throughout the upper 80% of its torque range within +/- 4%. Torque wrenches are not necessarily accurate in the lower 20% of their full range and should not be used for testing in that lowest 20% range.

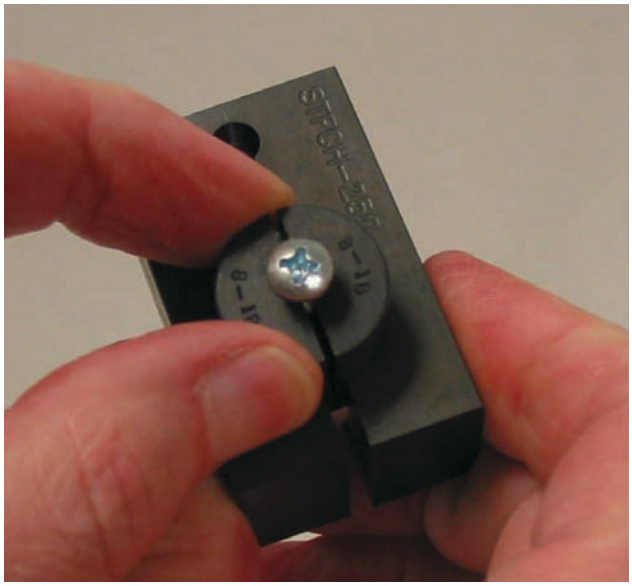
The step-by-step procedure is as follows:

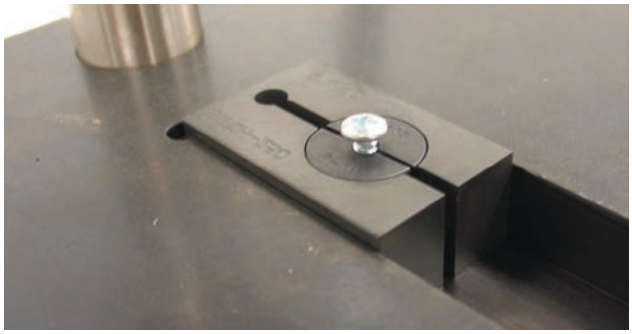
Torsional Test Procedure

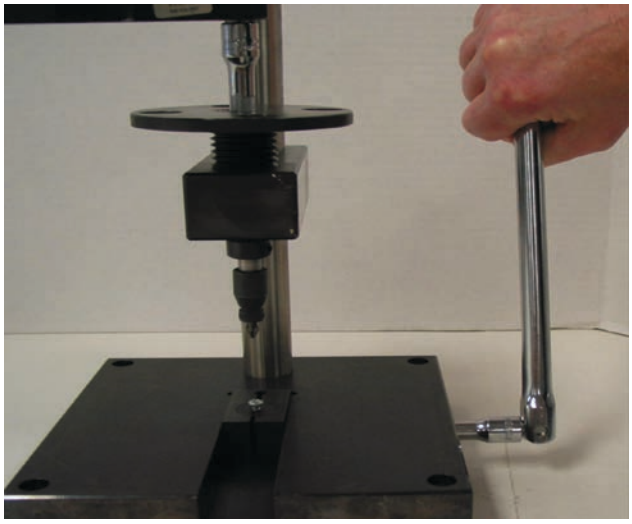
[1] The split collet that matches the test screw's size and thread pitch is selected and the screw is screwed into the collet while the collet is not yet clamped in the fixture's base. For proper testing at least two screw thread pitches must remain above the top surface of the collet:



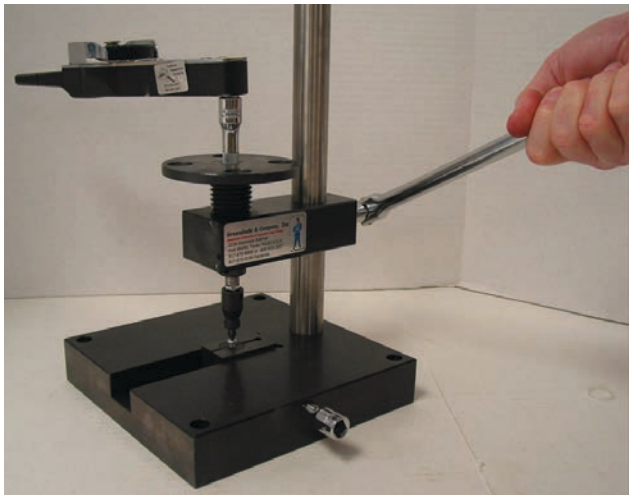
[2] The collet is placed in the split collet holder. The split collet holder is then placed in the fixture's base so that the screw is positioned directly below the rotating spindle of the fixture. The clamp screw in the fixture's base in tightened sufficiently tight to prevent the screw from turning in the collet when the torsional force is applied to the screw.







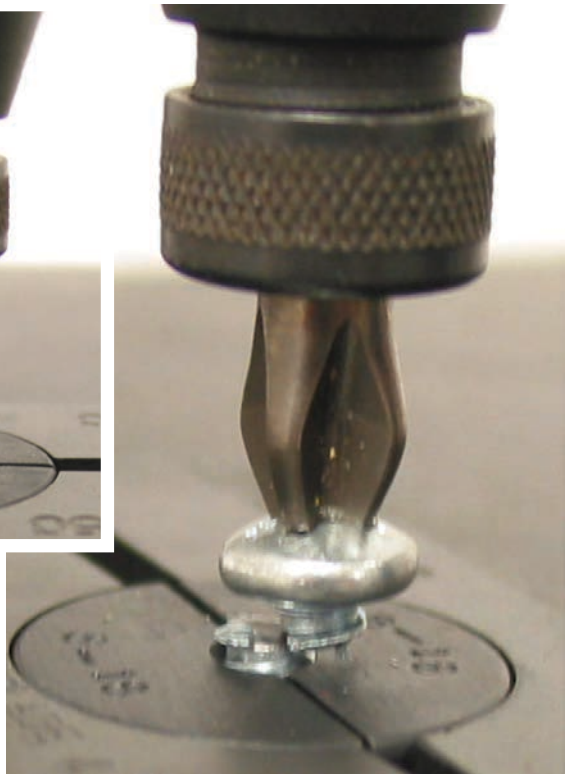
[3] The appropriate style and size driver bit or socket is affixed to the lower end of the fixture's rotating shaft using an adaptor or bit holder if necessary. The upper arm is lowered until the bit or socket fully engages the screw's recess or head and the upper arm is firmly clamped to the fixture's main shaft. The driver or socket's height relative to the screw's head can be adjusted by rotating the threaded adjustment wheel which houses the fixture's rotating shaft in the upper arm.



[4] The torque wrench is firmly engaged in the upper end of the rotating shaft's female square recess. The wrenches indicator is set to "zero" before any force is exerted on the wrench.

[5] A smooth torsional force is exerted on the torque wrench in a rotary manner until the screw twists into two separate pieces. The torsional strength of the tested screw is the highest torque value observed on the wrench at any point during the test.

All torque wrenches have a specific point on the handle where the force must be exerted to achieve accurate torque values. This point is designated as a notch, pivot, or by some other means. The operator's force should be concentrated at that designated location on the wrench handle to achieve accurate and repeatable results.



Torsional strength testing is an integral part of many screw standards and specifications. When screws exceed their minimum specified torsional strength in the applicable standard or specification it is a good indication that the screw will perform properly in its intended application. Torsional tests should be performed by screw suppliers using the appropriate testing apparatus and the correct test procedure to assure the validity of the results obtained by testing.