TORQUE

Threaded Fastener Torque Tightening Program

Powerful yet easy to use PC software that has been designed to assist you in solving problems related to the torque tightening of threaded fasteners

The Problem

A survey of car service managers completed in the United States, indicated that 23% of all service problems were traceable to loose fasteners. Such problems are common across many industries. A major cause of fastener loosening is inadequate tightening. A single bolt, inaccurately or incorrectly tightened, can lead to the failure of the complete product.

Program Overview

TORQUE is designed for use under the Microsoft Windows operating systems (Windows 95, Windows 98 or Windows NT) and will determine the tightening torque and preload for a threaded fastener. The program is designed to assist the Engineer in the solution of problems related to the torque tightening of threaded fasteners. The program determines both tensile stress due to the elongation of the fastener, and the torsional stress due to the applied torque. It accounts for the frictional effects in the thread and between the nut face and clamped surface. Account can also be made for the effects of a reduced shank diameter (smaller than the thread size) and a prevailing torque. The prevailing torque is the torque required to run a nut down a thread before engagement with the joint surface. This resistance can be provided by a nylon insert, a distorted thread profile or the use of a thread adhesive. A prevailing torque can significantly affect the amount of preload provided by the fastener for a given tightening torque.

Torque Controlled Tightening

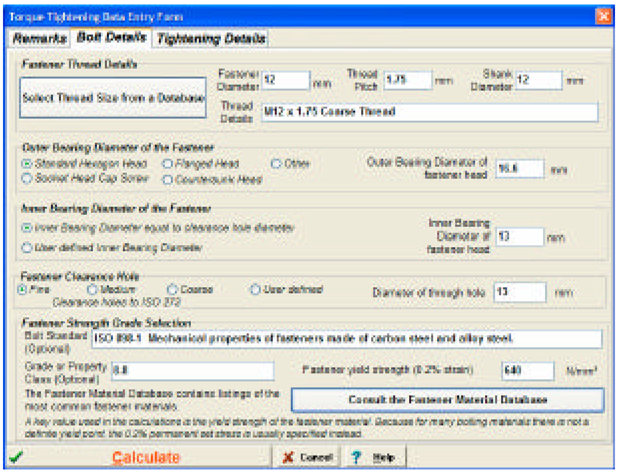
The most prevalent controlled method of tightening threaded fasteners is by tightening so that a specified torque is achieved. This method is generally known as torque control. The major problem related to this method is that the fastener clamp force (referred to as preload) generated as the result of an applied torque depends upon the fastener design and the prevailing frictional conditions. Despite the problems of potentially large preload variations occurring at the same torque level, torque control is still the most popular way of ensuring that an assembled bolt complies with an engineering specification. This is due to its simplicity and its widespread understanding by all engineers.

The Importance of Tightening Torque

Most Engineers already know the importance of a high preload in maintaining joint integrity. For torque controlled tightening, achieving the right preload is dependent upon the correct tightening torque being specified. Without the proper analytical tools and information, specifying the correct torque can be problematical. Whether you are a Service or a Design Engineer, you frequently need to know what is the correct tightening torque. For many types of threaded fasteners, this information is either not available, or not readily available.

The **TORQUE** program can help by providing you with a state of the art tool that will assist you in establishing what is the correct torque for a given set of conditions and what the preload value will be.

Presented at below is the data entry screen (when metric units have been selected) from the **TORQUE** program showing the ease at which data can be entered. Once the thread diameter has been entered, default values (that can be edited) are filled in automatically by the program.



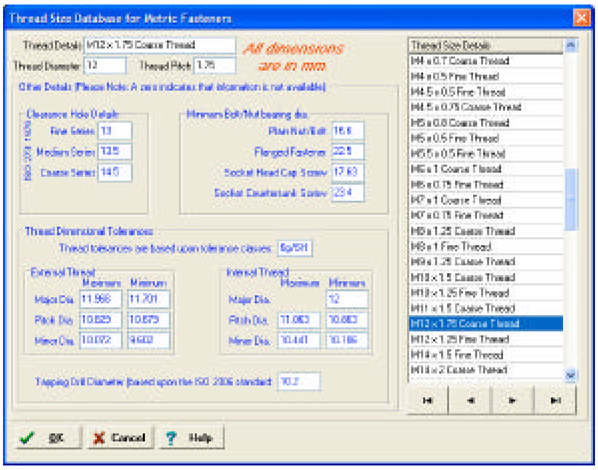
Help

Help is available which can furnish information relating to both the program and to threaded fasteners in general.

An in-built database is provided containing information appertaining to thread pitch, root, effective and nut bearing diameters for standard fasteners. The default metric coarse thread data used by the program can be changed to metric fine, Unified Coarse or Unified Fine by selecting the appropriate menu option. The program can also use metric or imperial units.

Analysis of Bolted Joints

A great deal of sophistication can nowadays be applied to the analysis of structures. Frequently however, the assumptions made in the analysis regarding the value of a bolt's preload is often simplistic considering the effort frequently placed on establishing the correctness of data. Frequently, this can be a fatal flaw in the structural analysis. Fluctuation in a bolt's preload is mainly caused by variations in the frictional conditions and the method of tightening being used. If this fluctuation is outside the assumed value, product reliability problems can result. Such reliability problems can manifest themselves as fluid leakage past a gasket, fatigue failure of the bolt itself or of the whole joint. Being able to predict what will be the fastener preload can be crucial to the reliability of a product.



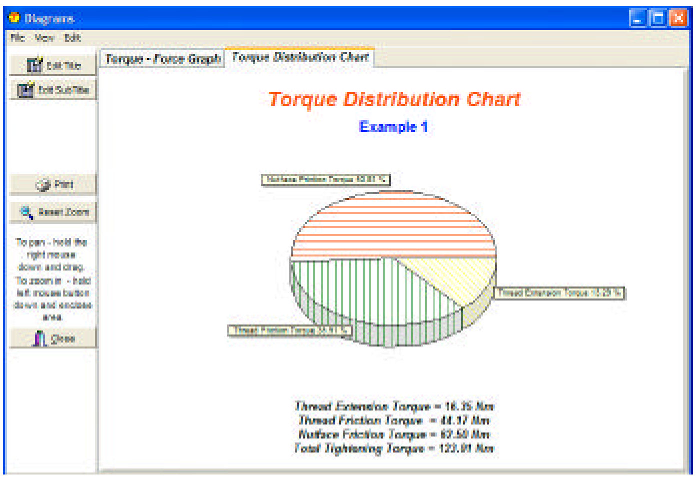
Versatile Analysis Options

The program will work either in metric or imperial units, the analysis options include the determination of :

a) The tightening torque and preload so that a given stress level is achieved in the fastener.

b) The tightening torque having specified the preload required.

c) The preload having specified the tightening torque.



Example Problem

Presented below is the analysis output by the TORQUE program for a M12 fastener with a prevailing torque.

TORQUE TIGHTENING ANALYSIS RESULTS

FASTENER DETAILS

Fastener Diameter	= 12.00 mm
Fastener Shank Diameter	= 12.00 mm
Thread Pitch	= 1.75 mm
Included angle between the thread flanks	= 60.00 degrees
Thread Pitch Diameter	= 10.863 mm
Thread Root Diameter	= 9.853 mm
Diameter related to the Thread Stress Area	= 10.358 mm
Thread Stress Area	= 84.264 mm²
Thread Root Area	= 76.248 mm²
Bearing Area under Nut/Bolt Head	= 99.620 mm²
Fastener Outer Bearing Diameter	= 17.20 mm
Fastener Inner Bearing Diameter	= 13.00 mm
Fastener Clearance Hole Diameter	= 13.00 mm
Effective friction diameter of nut/bolt	= 15.20 mm
Fastener Yield Strength	= 640.00 N/mm²

JOINT ASSEMBLY DETAILS

Zinc plated steel external thread, zinc plated steel internal thread, oiled.

Zinc plated steel nut or bolt, oiled, machined steel bearing surface.

Prevailing torque caused by a nylon/polyester patch on the threads.

Thread Friction Value	= 0.100
Nut/Bolt Head Friction Value	= 0.100

TORQUE TIGHTENING ANALYSIS RESULTS

Yield Point Tightening Factor specified	= 0.90
Total Tightening Torque	= 77.62 Nm
This torque is composed from:	
Torque needed to extend the fastener	= 9.47 Nm
Torque needed to overcome thread friction	= 21.32 Nm
Torque needed to overcome nutface friction	= 25.83 Nm
Prevailing Torque Value	= 21.00 Nm

FORCE ANALYSIS RESULTS

Fastener Preload	= 33996.13 N
Direct Force that would Yield the Fastener	= 53928.91 N
Preload as a percentage of Yield Force	= 63.04 %

MAXIMUM STRESSES INDUCED INTO THE FASTENER

Percentage of the yield strength utilised	= 90.00 %
Von-Mises Equivalent Stress	= 576.00 N/mm²
Tensile Stress due to Preload	= 403.45 N/mm²
Torsional Stress due to the applied torque	= 237.35 N/mm²
Surface Pressure under the Nut Face	= 341.26 N/mm²

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TORQUE is produced and marketed by Bolt Science Limited. A demonstration program is available from our website which also provides additional information related to bolted joint technology. Bolt Science reserves the right to improve this product without notice.