3

Inspecting the Tightening Torque

Methods of Inspecting the Tightening Torque

Methods of inspecting the tightening torque

Estimate how much torque was applied in the screw tightening, and carry out an inspection of the tightening operation with the following methods.

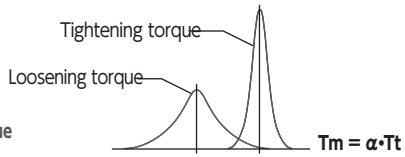
■ Loosening Torque ■ Retightening Torque ■ Marking ■ T-point

Table 3-1. Methods of inspecting the tightening torque

Method	Loosening Torque	Retightening Torque	Marking	T-Point
Measuring method	Loosen the bolt using a torque wrench and read the torque when the bolt starts moving.	Tighten the bolt further to determine the applied torque. Read the torque when the bolt starts moving again.	Mark the position of the tightened bolt, loosen it and read the torque when retightening it up to the marked position.	When continuing to tighten a bolt that has already been tightened with a torque wrench until the bolt begins to turn again, this torque value can be calculated by using the θ - t wave formula.
Measured torque / Tightening torque = α	0.6 ~ 0.9 ※ (0.8)	0.9 ~ 1.2 ※ (1.05)	0.9 ~ 1.1 ※ (1.0)	0.9 ~ 1.1 ※ (1.0)
Advantages/ Disadvantages	Relatively easy to measure. It is necessary to retighten the bolt. Often used for sizes of M4 or less.	Accuracy is obtained if the point at which rotation begins is distinct. No further work is necessary after the inspection.	Takes time and labor. After the inspection, the bolt is maintained at its original torque.	Measurement will be most accurate when the test piece is secured. The bolt can be left "as it is" after the inspection is complete and no individual variations will result.

α : Ratio between measuring torque and tightening torque
※ : Approximate value obtained by experiment

Figure 3-1. Variation of tightening torque and loosening torque



$Tm = \alpha \cdot Tt$
$(Tm) \neq Tt$

Tm : Measuring torque
Tt : Estimated tightening torque
α : Coefficient

3-1 Retightening Torque Methods

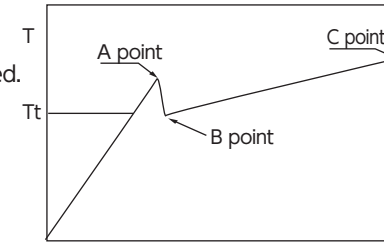
Retightening torque methods

The retightening method requires that additional torque is applied to a bolt or screw which has already been tightened, and then measures the torque value when the bolt just begins to move again. For standard screws:

- **Torque to overcome the static friction of the screw (A point)**
- **Torque when the screw starts to turn continuously (B point)**
- **Maximum torque for the inspection (C point)**

These measuring methods are used according to the accuracy required.

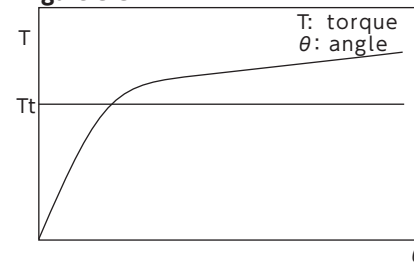
Figure 3-2. Typical torque change on retightening



(1) A-point method

The torque value when the bolt just begins to move again measurement is relatively easy and is not greatly affected by individual interpretation or performance. But because this method measures the torque value by static friction, the value will be higher than the tightening torque (Tt) and the relationship is not clear. Sometimes the maximum value by static friction (A point) may not exist for some screws (Figure 3-3).

Figure 3-3.



(2) B-point method

Technical experience is necessary to measure this point. The retightening torque will reduce temporarily and the reading accuracy is not very high, but this value is the closest to the tightening torque (Tt). Sometimes a clear minimum torque may not exist for some screws.

(3) C-point method

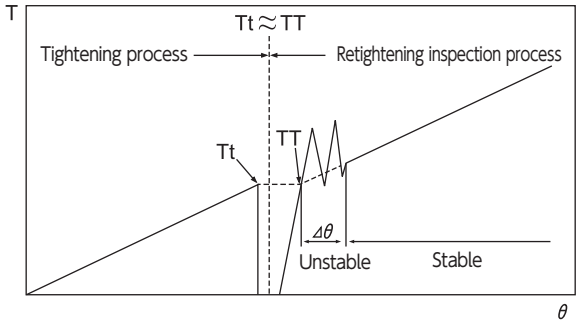
Measurement is easy by checking the maximum torque using a memory pointer. But the measurement value may change considerably depending on the operator's sensation and where they stop when the screw starts turning, so individual interpretation and performance can be a large factor. Generally, tightening torque means the C point method. The C point may sometimes show the A point.

3-2 Proposal of New Retightening Method (T-point Method)

Proposal of new retightening method (T-point method)

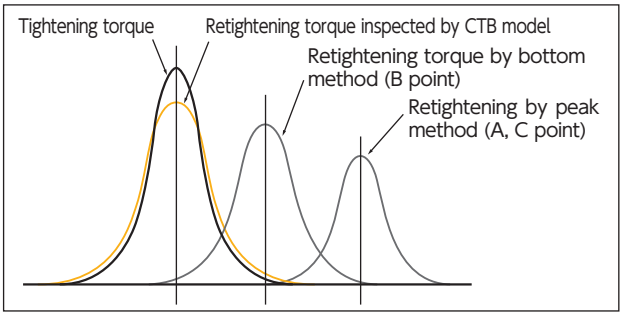
The retightening torque first starts with the rotation of the head only, and then causes the rotation of the screw, shifting from static friction to dynamic friction, before friction whip subsides to become a stable straight line. (Figure 3-4) Basically this straight line is an extension of the torque angle line figure obtained during the tightening.

Figure 3-4. New retightening method



Compared with the conventional A, B, and C point methods, the new retightening method (T-point method) will have less dispersion in the measurements, and in addition its central value will almost match the tightening torque. Unlike the A, B, and C point methods, compensation using offsets will not be required. The general offsets and dispersions of the tightening torque for each method in situations where there is no loosening or galling are shown in Figure 3-5.

Figure 3-5. Distribution of retightening torque



Advantages of the New Retightening Method

- Anyone can measure the tightening torque easily.
- No individual interpretation or performance variable is involved in measuring the torque.
- Requires less time to perform the measurement.
- Dispersion of data is small.